EDITORIAL

AS we go to press, we note that the Postmaster General has called for tenders to construct a co-axial transmission line between Sydney and Melbourne via Canberra.

Extra traffic channels between our capital cities are becoming more and more essential as the pressure upon them grows, and the only useful method of expansion is via wide band co-axial cables or micro-wave radio links.

Until such links are available, we will have no prospect of exchanging T.V. programs throughout the Commonwealth. It is quite impracticable to send T.V. signals over telephone lines for such long distances.

Considerable diversion of opinion exists between engineers as to whether radio links are better than co-axial lines. Radio links are fine for jumping over mountainous country, for instance, where co-axial cables would be almost impossible to lay down. They are generally spaced about 40 miles apart, whereas cables need repeater points about every nine miles.

There are too many pertinent factors to make any easy estimate or comparison.

It may well be that the most practical link would be a combination of both cable and radio.

But it seems certain that a single link will be only a starting point, for such huge capital cost must be integrated with communication services as a whole. Experience overseas has shown that more channels can be needed for T.V. services than for communications, for the same channel which will transmit a single T.V. program will handle about 600 telephone circuits.

When T.V. really gets going in this country, there will probably be pretty constant use for at least one channel on T.V., and we cannot visualise a situation in which so many telephone circuits are put out of action.

Whether the P.M.G. decides to use cables, radio links or both, the main thing is that an early start is planned.

It is unfortunate that in such a large country our centres of population and commercial activity are so widely dispersed, for it makes such projects extremely costly to install and to use, but our scattered State makes the need for good communications all the more pressing.

It will not be long before T.V. is established as a very special means of communication, and we must include interstate links among those things which are part and parcel of the T.V. system. Let's hope that these new facilities can be pushed along with the greatest speed.

John Moyle

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EDITOR
JOHN MOYLE
S.M.I.R.E. (Aust.)

TECHNICAL EDITOR
NEVILLE WILLIAMS
M.I.R.E. (Aust.)

MAURICE FINDLAY
A.S.T.C.

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OUR COVER PICTURE

HOW'S THIS FOR A CAMERA? — One of the latest Hasselblad cameras fitted with a telephoto lens recently on show at Olympia in London. It takes 35 mill. pictures, has interchangeable lenses and costs about £800.

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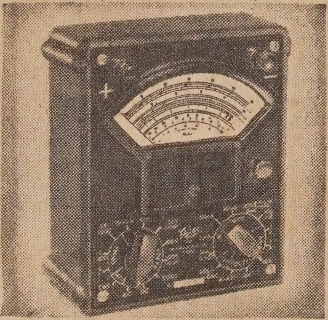

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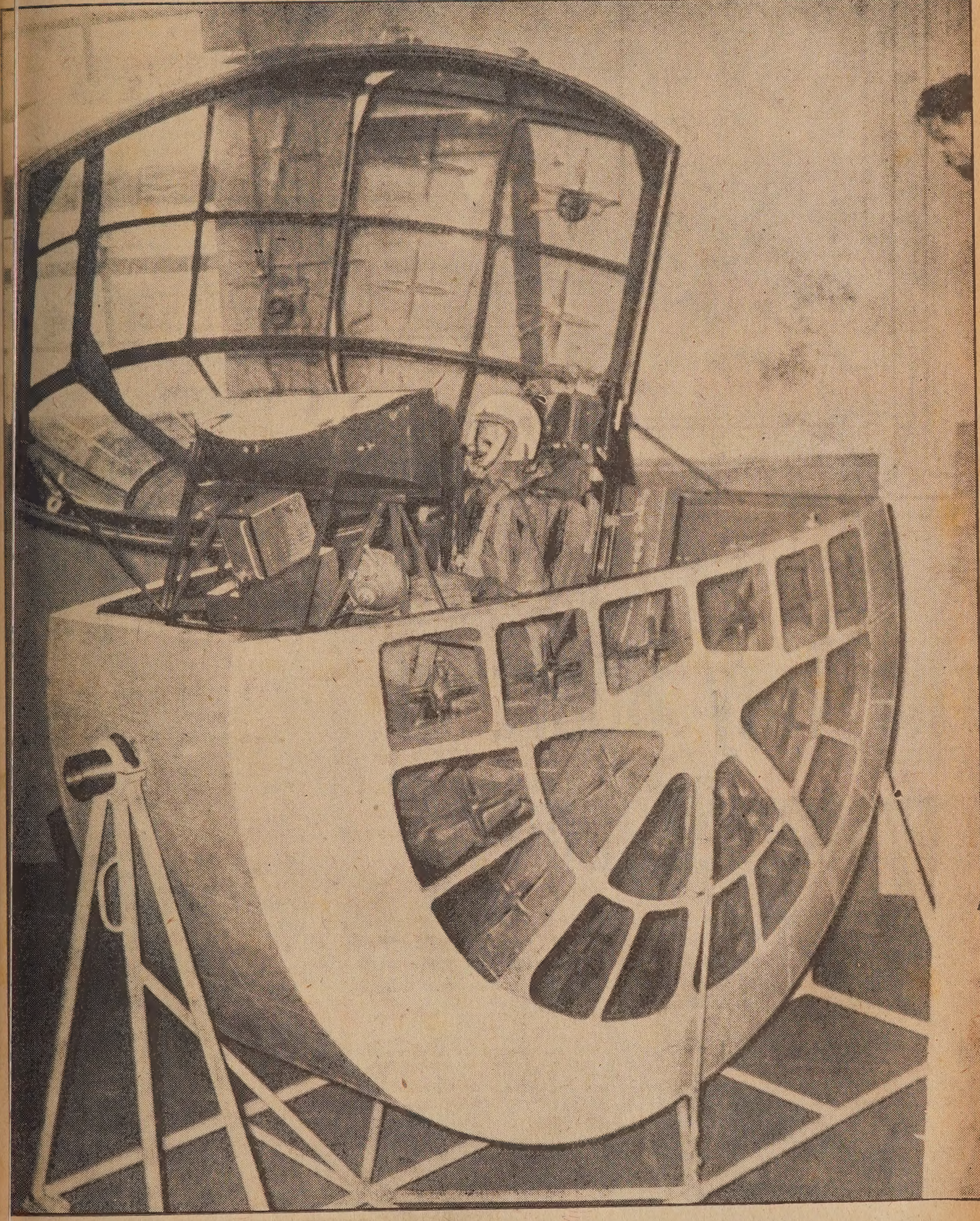
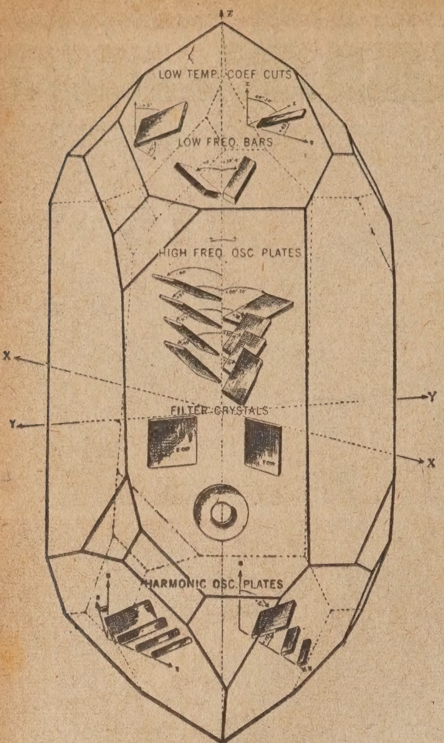
FLIGHT TESTING BY T.V. CAMERA



TO TEST FRENCH AIRMEN this centrifuge has been installed in the Medico-Physiological section of the Bretigny flight test centre. It is used for measuring the physical resistance of the pilot to acceleration, and the development of protective clothing. The pilot, shown seated, is whirled around at speed as the device is rotated on its central shaft. A T.V. camera registers his reactions.



Left: This diagram shows the orientation of oscillator and fil crystals with respect to the ones of the "mother" or natu crystal. Each cut has its own particular use.

1: The correct sawing angle of the crystal as determined by x-r analysis, is assured by orientating the specimen on th machine.
2: The next step is to place the glass mounted crystal under diamond-edged saw. The saw table is fitted to slice the qua along the desired plane.
3: Wafers are diced into segments by a smaller diamond edg wheel.
4: Here are the prepared blanks ready for grinding to their d sired thickness.
5: The crystal blanks (here circular in shape) are ground "lapped" to thickness in this device. The top grinding pla seen hanging on the peg and coated with grinding powd is rotated over the bottom plate holding the blanks.
6: This precision guage will check accuracy of lapping to o ten-thousandth of an inch. Finally, the frequency of the cryst is compared with known standards over a wide temperatu range.

The Tiny Heart of Crystal Stability

The discovery of the piezo-electric effects of quartz crystals revolutionised the frequency stability of transmitting equipment. Recent developments of the ultra high frequency bands for communication have been made possible by the remarkable accuracy in control achieved by these tiny wafers of quartz. This picture story tells you how crystals are made.

MILLIONS of people operate their radio receivers and find each station precisely on its assigned frequency. The twist of a selector switch on a television set brings in the desired picture on its correct high-frequency channel. A fogbound ship at sea obtains its bearings accurately from distant shore stations. An airliner makes a perfect landing in zero-zero weather. Police cars converge on an escaping criminal. A businessman speeding along a highway reports to his home office by radio. Scattered groups of armed forces keep in constant touch with their commanding officer. Photographs are transmitted to distant points by radio signals. Much of the world's business is conducted through this modern phenomenon of radio communication, which fills the radio frequency spectrum with a multiplicity of signals.

CRYSTAL CONTROL

How is it possible, then, to avoid a Babel of meaningle dots and dashes and unintelligible voices? The answer twofold. First, government and international regulatio assign to each class of communication specific portions, the frequency spectrum, like a certain group of keys c a piano.

Second, each transmitting station is kept precisely c its particular frequency by a remarkable little device calle a "Crystal Unit."

The heart of this unit is a small quartz plate, fashione with precision from a single crystal of silicon dioxide. its raw form, this material looks much like a hexagonal pris of glass, with somewhat irregular, tapering sides that termina in a pyramidal apex at each end.

Natural quartz crystals are found in many parts of th earth, but the largest and best specimens come from mou tains of Brazil. The age of these crystals and the conditio under which they grew are subjects of much speculatio Although found thousands of feet above sea level, it is believe they were formed thousands and perhaps millions of yea ago, when that part of the earth was submerged deep in th bed of the ocean.

PIEZO-ELECTRICITY

Whatever their true history, it ha been discovered that these crystals po sess a remarkable property.

When mechanically compressed alon certain directions, electrical charges ar formed and, conversely, when electrica voltages are applied, mechanical disto tion of the crystal takes place.

This piezo-electric property is foun in many other crystals, but none has s many desirable features. Hardnes durability and economy of procureme make quartz outstanding for stabilise control of radio frequencies.

RESONANT FREQUENCY

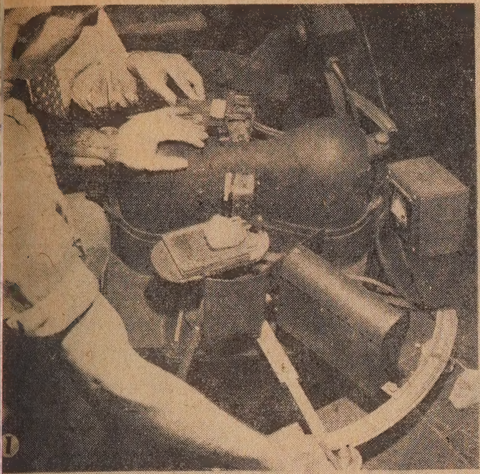
How can small pieces of rock be use to control radio frequencies?

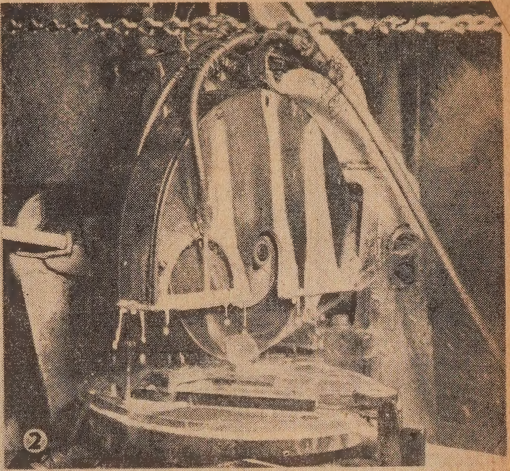
The answer rests in another uniqu property of quartz crystals. When th raw material is cut into thin wafers i certain directions by means of diamon saws, and rectangular or circular plates are fashioned fror these wafers, each has the property of offering high resistanc to all but certain critical frequencies.

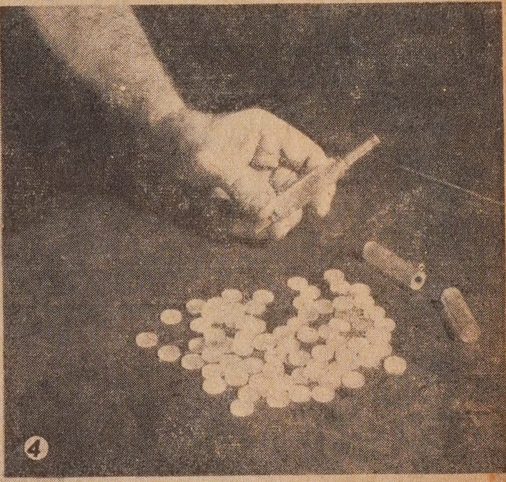
These are determined by both the orientation of th wafer from the mother quartz and the final dimensions c the crystal. Critical frequencies or resonant points may b shifted to any desired value by slight changes in boundar dimensions.

At each such resonant point the resistance or impedanc of the quartz plate drops to a low value. This behaviou combined with the piezo-electric property, permits an electroni circuit to function normally. The only frequency at whic the circuit can be employed is the exact resonant frequenc of the crystal, or at one of its harmonics.

METHODS OF CUTTING AND GRINDING CRYSTALS







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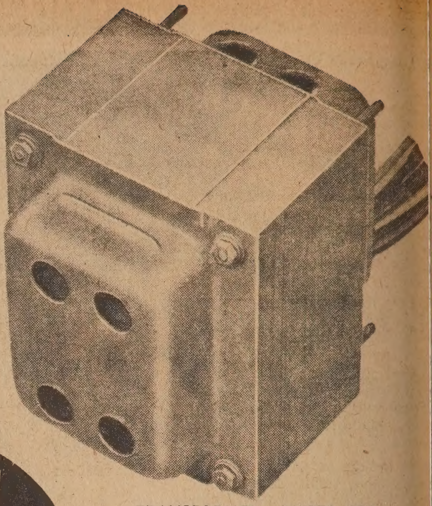
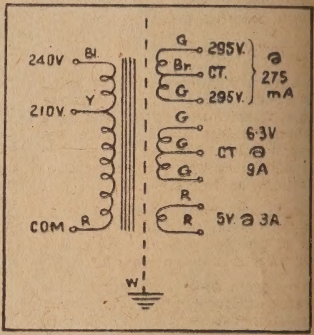


TRANSFORMER RH275/295
Dimensions (upright mounting)
4½in x 3¾in, chassis height 4¼in.



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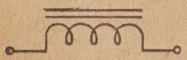

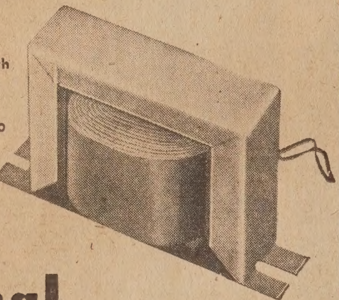

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Order is established in the radio spectrum by a high degree of frequency stability, and in a large majority of cases this is obtained by using crystal control of all transmitters.

Since this was made possible more than 20 years ago, what is the justification for continued research?

The usable radio spectrum is, at the present, limited to frequencies extending to a few thousand megacycles, with the vast majority of all radio communication taking place at much lower frequencies. The important consideration is that **there exists a practical limitation to the width of the usable radio frequency spectrum,** and already the demand for channel allocations is so great that there is not enough room for all unless the width of each channel can be reduced.

The actual width required for each channel of communication depends upon two things, first the type of transmission employed and, second, the degree of frequency stability which can be maintained.

Even though crystal-controlled, the frequency may drift slightly from its assigned value.

Temperature changes, vibration and aging cause the properties of the crystal to change slightly, with a corresponding variation in resonant frequency.

FREQUENCY DRIFT

It is quite common practice to avoid drifting effects owing to temperature variations by enclosing the crystal in a constant-temperature oven. There are many applications, however, where the weight, size or power requirements of ovens cannot be tolerated.

The only remaining possibility is to fashion the crystal so that its tendency to drift is greatly reduced. Here is a problem for the research engineer.

Our engineers have determined to a high degree of precision the exact angles of orientation at which the finished quartz plates must be fabricated for lowest frequency drift. X-ray measurements of atomic planes within the quartz are used to an accuracy of less than one minute of arc. The optimum orientation is not a constant angle for all frequencies, but must be varied according to orientation curves, depending upon frequency and crystal boundary dimensions.

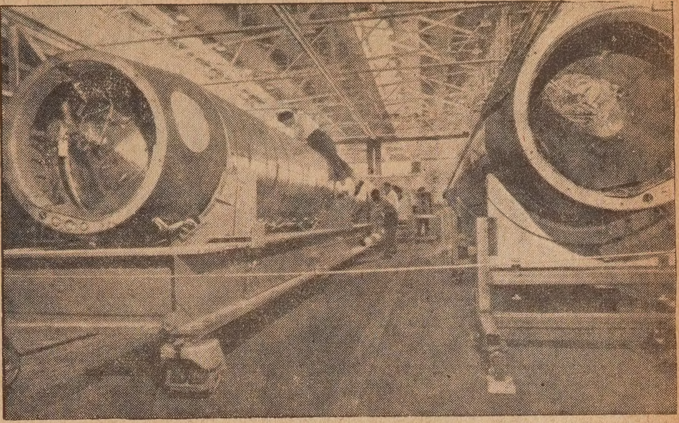
AGING EFFECTS

Developing crystal fabrication techniques that will decrease frequency drift caused by aging is a second problem confronting the research engineer. This is far more serious than suspected.

Aging effects can cause gradual frequency deviations far outside permissible limits, and this in a short time. By recognising the existence of damaged crystal surfaces, engineers took a large step towards minimising the causes for this behaviour. Abrasives employed in lapping produced faults, which are now eliminated by dissolution in a potent chemical such as hydro-fluoric acid.

After the etching operation, it was also found beneficial to submit all crystals to a high-temperature baking cycle, such as an annealing process, to remove any final traces of strained areas within the quartz plate. These practices, which we have employed for the past 10 years, are now generally recognised as effective anti-aging treatment.

WILL CARRY EARTH SATELLITE



First picture of the giant, 3-stage Vanguard rockets designed to carry the first earth satellites into space, taken at the Martin Co. plant in Baltimore, U.S.A.

Although usable radio frequencies extend to thousands of megacycles per second, the major portion of crystal-controlled frequencies lies below 200 megacycles.

Crystals with natural resonant frequencies of this value are not as yet commercially available, and unless employed in circuits specially designed to excite them at overtone or harmonic modes, the top practical frequency limit for crystals is about 16 megacycles.

OVERTONE CIRCUITS

To arrive at the desired carrier frequencies between 16 and 200 megacycles it has been necessary to use frequency multiplier stages or special "overtone" circuits. The early method was to use a series of frequency doubling or tripling stages in the transmitter design. This system is still employed in many high-power, fixed stations; but where space and weight are at a premium, it is far more desirable to have the oscillator circuit itself operating at the carrier frequency or as near that as may be feasible.

Fifteen years ago engineers discovered that a **specially fabricated quartz plate could be operated at three times its fundamental frequency.** This had the effect of reducing the number of frequency multiplier stages required.

Later developments showed that similar "overtone" crystals could be used reliably when operating at higher orders of odd harmonics, such as the fifth, seventh, ninth, etc. There are but few practical uses of these units above the third overtone, but here research shows that the fifth, seventh and ninth modes may also be employed with dependability.

This development is extending crystal oscillators to higher and higher frequencies. Five years ago the top frequency for a crystal of the overtone type was about 20 megacycles; to-day, that limit has been advanced to 50 megacycles. **The top limit, however, has not been reached.**

A factor contributing to reduction in size is the deposition of the two metal electrodes directly to the major faces of the quartz plate in the form of thin metallic films. The fabrication of plated crystals was pioneered during World War II, when millions of plated, high-frequency crystal units were supplied for the armed services. The original electrode material of **evaporated aluminium was changed to silver** for better electrical contact. **Present research is advocating the use of gold,** because of improved stability characteristics.

SMALLER AND LIGHTER

Whatever the material employed, the weight per unit is far less than former designs which used thick, separate, metal electrodes. A modern, hermetically sealed crystal with plated electrodes weighs but one-ninth of an ounce, as compared to a prewar unit of the same frequency, weighing almost five ounces. Equally startling is to note that a prewar crystal occupied a space of more than 2¼ cubic inches, whereas its modern equivalent requires less than two-tenths of one cubic inch.

Crystal engineering research still goes on. Primary objectives are to expand the frequency range of both fundamental and overtone crystals, to improve constructional features and to increase heat dissipation properties. This will expand the usable frequency spectrum, give greater stability, and enable larger amounts of power to be handled. Circuits are being developed for measuring performance characteristics and to further minimise aging effects. These efforts to attain greater precision and frequency stability help conserve frequency spectrum space by reducing channel widths.

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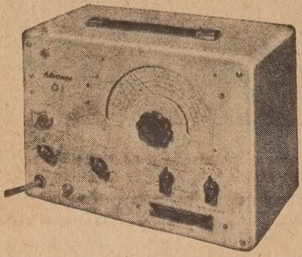

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\ fast airliner from Britain ouches down and the passengers, with the air of London arely out of their lungs, come own the gangway. Then, unbtrusively, an official extracts rom the wing-tip of the aircraft small container. Here's another xpress consignment of atoms, he export of which is becoming n important part of British nuclear activity.

By NIGEL CALDER

EVERY week, from its laboratories at Harwell, England, and its radio-cl mical centre at Amersham, England, th United Kingdom Atomic Energy A hority despatches more than 200 sa ples of "radioactive isotopes" to c ntries overseas. They are atoms of fa iliar chemical elements like carbon, p sphorus, iodine and gold, but they a "hot"—giving off atomic rays during a rocess of radioactive decay.

ARIETY OF USES

Many radioactive materials lose their r ioactivity rapidly — sodium for e ample loses half its strength in 15 h urs—and because they decay in a few d ys and give out dangerous amounts of r liation this "half-life" as it is called i so short, consignments have to go by a . Because of the weight of protec- t e containers this was an expensive u dertaking, making medical use costly u til Dr. E. C. Halliday, of Pretoria, h on the idea of carrying them in the w ng-tips. This is now a normal facility i British aircraft.

Ordinary atoms can be made into r lioactive isotopes by "cooking" them i a nuclear reactor; some are to be f und in the spent fuel-rods of the rea tor—the fragments of split uranium a oms. By whatever means they are crea ed, they have an astonishing variety of u es.

The medical applications are well k own. Radioactive cobalt, Co-60, makes cheap substitute for radium in treating ep-seated cancer and its powerful mma rays destroy the cancer as surely a surgeon's knife. For other cancers d tumours, there is radioactive gold, u-198. And many hospitals receive dioactive iodine I131 for the diagnosis d treatment of thyroid trouble.

Atomic rays can penetrate deep into odstuffs and interrupt the normal living ocesses which make them deteriorate. aw beef will keep about three or four nes longer in a refrigerator if it is st treated with atomic rays.

Harmful parasites in pork and poisonus bacteria in eggs can be destroyed in e same way. But the taste of food may affected, so there are still difficulties eventing the immediate adoption of e techniques.

MAKING THINGS GO

Almost every industry has jobs where "hot" atoms can help to make things go more slickly. Let me give a few examples out of hundreds.

Perhaps you are a water engineer and you want to find a leak in an underground pipe. If you just introduce a harmless amount of radioactivity nito the water you can follow its progress from above the ground with a Geiger counter.

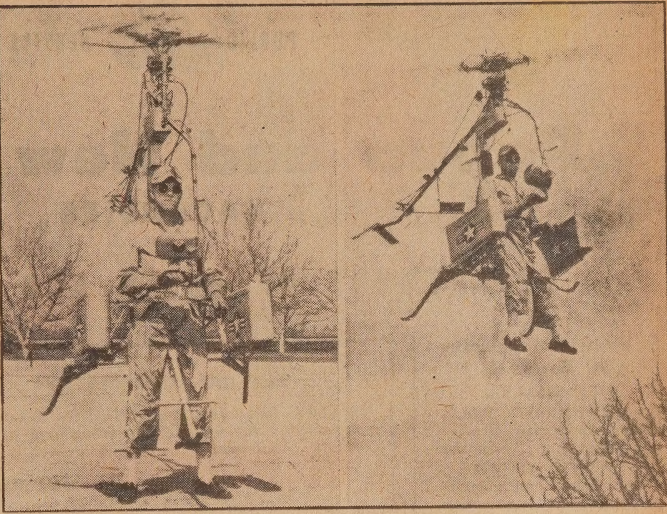
If you make petrol engines it would be useful for you to know how quickly a piston becomes worn in various circumstances. You can send the piston to Harwell and get them to cook it in a reactor so that the metal becomes radioactive. Then you can put it in the engine and detect the minutest amount of wear by testing the oil for radioactivity.

You will almost certainly want to check your castings by radiography to make sure there are no hidden flaws; you could use a cumbersome and expensive x-ray machine, but it is much easier just to put a speck of radioactive caesium, Cs-137, on one side of the casting and a photographic plate on the other.

But this is just the beginning of the radio-isotope story. It is little more than 10 years since "hot" atoms came on the market. Already, chemists have found that they can use atomic rays in making new plastics and synthetic rubbers, and for vulcanising natural rubber.

And scientists investigating the chemical processes of life can introduce radioactive "tracers" into a living organism; the "hot" atoms go through the same chemical antics as their stable counterparts, but they give themselves away by their radio-activity. One of the mysteries investigated in this way is the chemical effect of sunlight on plants.

NEW STRAP-ON-BACK HELICOPTER



Pilot Dick Whitehead goes aloft in a new, one-man, strap-on-the-back helicopter known as the "Pin Wheel" and built by Roto-Craft of Glendale, California. Powered by rockets, it is designed to fly an infantryman and his equipment about a battle-field regardless of obstructions or terrain. Its manufacturers hope to sell it to the U.S. Army.

TINY ATOMIC BATTERY POWERS WRIST WATCH

PROMETHIUM a radioactive fission product of nuclear reactors and an element non-existent in nature, finds one of its first uses in a novel atomic battery. The tiny battery was developed by an American company for use in a wrist watch. Similar batteries are expected to be used to power portable radio receivers, hearing aids, equipment in guided missiles, &c.

First the battery yields light, which it then turns into electricity. Beta rays from Promethium 147 oxide make cadmium sulphide, a light-emitting phosphor, glow. Silicon photocells transform the light into 20 microwatts of power in the present model but larger and more powerful models are expected to be developed.

A shielding alloy 1-16in. thick confines the mild radioactivity and amply safeguards the wearer of the watch.

The new battery is said to be immune to heat, cold and self-damage by radiation. Short-circuiting it does no harm and power drawn from it does not do it any harm. Lasting as long as its Promethium 147 (estimated half life about 2½ years), it retains one-fourth of its original power for five years, which is considered its useful life.

The promethium it uses, now costly, will become plentiful and inexpensive with quantity production.

PUBLIC SERVICE

OF

Papua and New Guinea

VACANCIES

DEPARTMENT OF POSTS AND TELEGRAPHS

Supervising Technician (Radio) Grade III

£1562-£1592 p.a.

Qualifications: P.M.G. Senior Technician (Radio) or equivalent; extensive VHF and HF experience.

Duties: Install and maintain regional radio communication equipment; inspect stations; supervise technical staff.

Senior Technician (Radio)

(5 positions)

£1232-£1292 p.a.

Qualifications: Pass in P.M.G. Senior Technician (Radio) examination or equivalent.

Duties: In charge zone transmitting and receiving stations (transmitters 500 W power); MF/HF, CW and radio-telephone trunk and out-station services.

Technician (Radio)

(5 positions)

£1062-£1172 p.a.

Qualifications: Pass in P.M.G. Technician (Radio) examination or equivalent; HF and VHF experience desirable.

Duties: Assist in maintenance and operation zone and out-station radio equipment.

Supervising Technician (Telecommunications) Grade II

£1442-£1472 p.a.

Qualifications: P.M.G. Senior Technician (Telecommunications) or equivalent; automatic and manual telephone experience essential; supervisory ability.

Duties: Install and maintain exchange equipment in district; supervise staff.

GENERAL INFORMATION

SALARY: *Rates quoted are actual for unmarried appointees and include allowances and adjustments. Additional Territorial allowance is paid as follows:—*

	Unmarried	*Married*
	£	£
Less than 5 years' service	—	125
5 years' service but less than 7	25	150
7 years' service and over	50	175

ELIGIBILITY: *Adult male British subjects under 45 years.*

APPOINTMENT: *Permanent subject to satisfactory probationary period.*

LOCATION: *Appointees are required to serve anywhere in the Territory.*

ACCOMMODATION: *Single quarters only available. Married accommodation not available under 18 months from date of appointment.*

SEPARATION ALLOWANCE: *Payable at discretion of Territory Administration; designed to compensate for added expense of married appointees obliged to maintain family outside Territory.*

LEAVE: *Three months after each 21 months in Territory. Additional 3 months' leave after each 6 years' service and 6 months' furlough after 20 years' service.*

TAXATION: *Income derived by residents of Territory from sources within Territory is **not** at present taxable under Commonwealth legislation.*

FURTHER INFORMATION: *An information Handbook on the Public Service of the Territory is available from the Department of Territories, Canberra or Sydney, or from any Commonwealth Public Service Inspector, District Employment Office or official country Post Office. Other enquiries to Department of Territories, Canberra ('Phone U 0411, Ext. 28A).*

APPLICATIONS: SUBMIT *on prescribed form available from offices mentioned under "Further Information".*

TO *The Secretary, Department of Territories, Canberra, by 6th July, 1957.*

Senior Technician (Telecommunications

£1232-£1292 p.a.

Qualifications: Pass P.M.
Senior Technician (Tel
communications) examin
tion or equivalent; automat
and manual telephone e
perience.

Duties: Install and mai
tain equipment at mai
exchange.

Technician (Telecommunications

(6 positions)

£1062-£1172 p.a.

Qualifications: Pass P.M.
Technician (Telecommun
cations) examination
equivalent; automatic an
manual telephone experienc

Duties: Install and maintai
equipment.

Senior Radio Telegraphist

£1232-£1292 p.a.

Qualifications: First Cla
Certificate of Proficienc
(P.M.G.) or equivalen
ability transmit and receiv
at 25 w.p.m. and touch typ
30 w.p.m.; two years' com
mercial experience desirabl

Line Foreman Grade

£1112-£1142 p.a.

Qualifications: P.M.G. Lin
Foreman or equivalent
cable, conduit and aeria
experience; leadershi
qualities.

Duties: Supervision staff i
field; maintenance plant an
equipment.

TOV43.94.57

HIGH-SPEED COMPUTER NO BIGGER THAN A T.V.

high-speed digital computer, t much larger than a home levision set and requiring less ower to operate, has been de-loped at Bell Telephone aboratories. This newest ad-tion to the family of electronic brains" was developed under ir Force contract. It has been amed "Leprechaun," after the icky sprite of Irish folklore.

Leprechaun is a new, high speed digital computer distinguished by its low power and size. It can be used as a research instrument for digital computers specially designed for military applications. Free use of transistors keeps power consumption small.

MPARED with previous computers, Leprechaun operates with a drastic-reduced number of components. Ex-ng its magnetic cores, it uses only t 9,000 electrical components. More half of these are transistors.

me 5,000 of them are used in Lep-chaun. The use of transistors made ble the small size and low power irements of the computer.

HIGHLY FLEXIBLE

prechaun represents a significant nce in computer design. One of its anding features is its flexibility. Its ponents can be easily connected and nnected. This allows the computer e used as a test model for research digital computers designed for mili-applications. Proposed new designs be laboratory-tested through the use of eprechaun without resorting to con-tion of new equipment.

nother feature of the new computer s ts transistor-driven "random-access netic core memory." The machine take its instructions immediately its memory, no matter where the red instruction may be stored. This ess differs from that of computers a "revolving drum memory" which require time for the rotation of the n before the instruction can be taken n its place.

lmost instantaneous solutions to the lems it has to solve are provided by rechaun since any of its stored in-st ctions are immediately available. E h instruction consists of the operation e performed, such as addition, multi-pl ation, etc., and the location of the d a in the memory.

DOESN'T FORGET

he machine can store 1,024 "words" in its memory. These words consist o 18 binary or dual digits, representing ructions or data to be used in solving blems. In computers, all information is translated into a special code which uses only combinations of 0 and 1. These binary digits can be represented in Leprechaun by the flow or absence of elec-tricity in the transistors, by the direction o magnetisation in the memory cores, or by holes in punched paper tape.

One reason for building Leprechaun was to demonstrate the feasibility of "rect coupled transistor logic." This is a switching circuit technique in which transistors are used to perform logic or "brain" operations as well as to provide power.

Compared with previous computers, the circuits of Leprechaun are very simple and easily understood. This is an advantage in engineering and maintenance, since less experienced personnel are required to keep it in operating condition. Leprechaun's simplicity and small number of components result in small size and weight and will permit the use of automation techniques in manufacturing. All these features ensure greater reliability, which is of primary importance in military operations.

While Leprechaun is still in the experimental stage, the techniques developed are expected to have many future applications.

X-RAY MICROSCOPE NEW TOOL FOR RESEARCH

A POWERFUL new tool for research into hitherto unexplored fields of metals, foods, chemicals and criminology is a new x-ray microscope recently produced in America.

While not as powerful in its magnifying power as the electron microscope, the x-ray microscope has an advantage in that it does not require mounting the specimen in a vacuum and other special preparation techniques.

Under development for more than four years, the x-ray microscope promises to reveal hidden facts concerning such vital facts as corrosion in metals, the effect of foreign materials in metals, the soundness of electroplated coatings, and the effects of various processes on the behaviour and structure of metals.

Secret of the x-ray microscope lies in the extremely tiny size of the focal spot, which is bombarded by electrons and thus caused to give off x-rays. This target is only 40 millionths of an inch in diameter. X-rays emanating from such a small spot fan out in all directions and hence magnify any object which they pass through. The x-ray microscope achieves magnifications up to 1,500 times, and at the same time discloses the inner structure of the object being examined.

Basically, this is how the x-ray microscope works: A narrow beam of electrons emerges from an electron "gun". This beam is cut down to desired size by a condenser lens, and then passes through an objective lens. The tiny beam then bombards the target made of a sheet of tungsten which is thick enough to stop the electrons but thin enough to permit the generated x-rays to pass through. The remainder of the instrument is a simple shadow projection microscope.

FOREMOST IN SOUND
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INSTRUCTING
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COMMUNICATION

There is a planned A.W.A. Sound Reproduction system for every need in the commercial, industrial, educational, cultural and entertainment activities in the community.

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ALSO FROM LEADING WHOLESALERS

TRANSISTOR PRODUCTION LINE

Big strides are being made in the transistor field. These pictures come to us from Delco Radio Division of General Motors, which has just produced a high-power transistor car radio set using no valves or vibrators. The method of makng transistors described here is now fairly standard.

GERMANIUM, the heart of the transistor, must be fantastically pe to operate properly.

Manufacturing processses purify the gmanium until there are approximately one billion germanium atoms to only o impurity.

But then it is too pure — for transisr action requires minute amounts o a known type of impurity.

The impurity in this case is antimony — one part to 10 million parts of germnium.

In the purifying process used at Delc Radio, a graphite "boat" of germnium requires some eight hours to mve through the special zone refining dvice. This zone refiner has a series o eight induction heating coils in its sne 12ft length which heat the germnium to its melting point eight times dring the process.

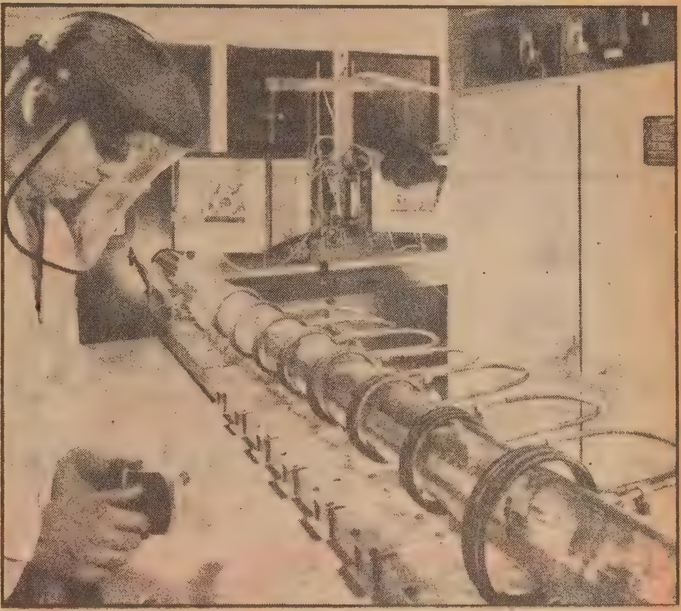
In between each coil the germanium cools, sweeping the impurities to the eds of the boat. Thus, each of the eht coils contributes to the purificatn of the germanium.

ROWING PROCESS

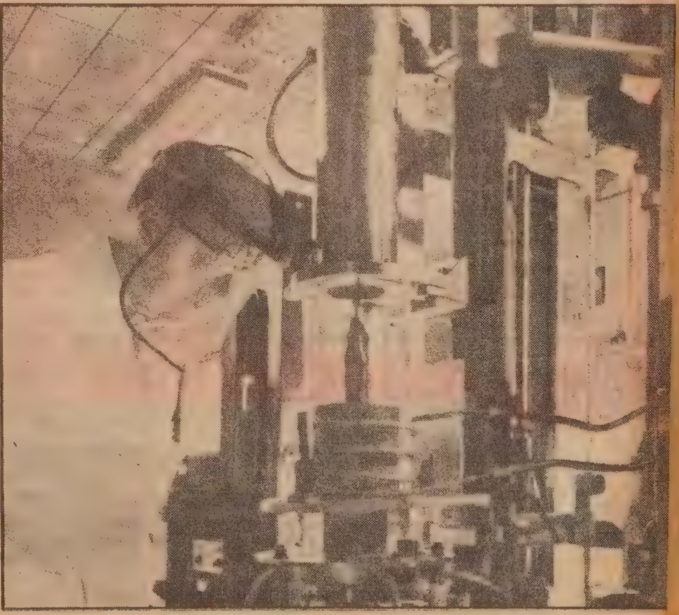
Once the germanium is purified, it tn is ready for the "doping" and the "owing" processes. In these processes t infinitesimal amount of antimony is aded and the germanium atoms are aanged to provide avenues for the crier of current, electrons and "oles".

To do this, a "seed" of germanium i which atoms are perfectly arranged i lattice-like structure is dipped into te molten germanium mixture. The sed is rotated slowly and imperceptibly thdrawn from this mixture. As it is thdrawn, molten germanium clings to and solidifies, growing a stick of rmanium some 11 inches long and bout an inch and a half in diameter hich is accomplished in approximately ve hours.

This single crystal stick is sawed by amond saws into thin slices. These ices are then ground to an accurate



This photograph shows a large induction heating coil around a quartz housing down which a graphite "boat" of germanium moves in some eight hours. Each coil heats the area beneath it to above 947 degrees Centigrade, the melting point of germanium. In between the coils the germanium cools, sweeping the impurities to the ends of the boat as crystallisation takes place. Thus each coil contributes to the process.



A physicist studies the growth of a large germanium crystal which can be seen in the centre of the quartz housing. In some five hours, the crystal will be about 11 inches long and half an inch thick, worth more than £1,500.. It will be cut into wafers three-tenths of an inch square and less than one hundredth of an inch thick.

ELECTRONIC A&R EQUIPMENT

TV NEWS

Available Now! A New A&R Transformer Kit for the R.T. & H. Television Receiver!

Mains Transformer

For the R. T. & H. 17" T.V. Receiver

MAINS TRANSFORMER: DESIGN P.T. 1840
Primary: 200, 230, 240V.
Secondary. 290-CT-290 V @ 275 mA
Filament: 6.3V @ 9 Amps. 5V @ 3A

Horizontal mounting this transformer is designed for low radiation, and in addition is fitted with a copper flux shorting shield to further reduce the external magnetic field. Colour- coded leads Height above chassis 3½in. Base size 4½in x 3¾in. Mounting centres 3¾in x 3in Cut out 3 1/8 in x 2 3/8in Weight 11¾lb.

Filter Choke

DESIGN Z 1091. Inductance 1 Hy. @ 275mA, D.C D.C. Resistance 30 ohms. A strap clamp mounting with leads. Designed for low voltage drop (Approximately 8 Volts at maximum current). Base size 4in x 2in Mounting centres 3 9/16in Height above chassis 2 9/16in Weight 2lb.

T.V. Kit

(Designed for use in T.V. circuit published by Philips Elect. Ind. Pty. Ltd.)

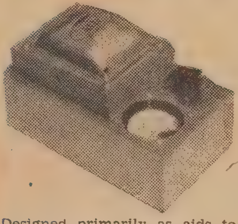
POWER TRANSFORMER: DESIGN P.T. 1790.
Primary: 200, 230, 240V 50 cps.
Secondary: 230-CT-230V @ 350 mA.
Filaments: 2 x 6.3V @ 6 A.

Horizontal mounting. Fitted with copper flux shorting shield. Colour-coded, flexible leads. Height above chassis. 3½in. Base size 4¾in x 3¾in Mounting centres 3¾in x 3 1/16in.

FRAME OUTPUT TRANSFORMER: DESIGN O.T. 2507
Designed to Philips' specifications. A strap clamp mounting, with colour-coded leads. Height above chassis. 2 9/16in. Mounting centres: 3 3/8in Base area 3¾in x 2 3/16in.

POWER CHOKE: DESIGN Z 1090.
Inductance: 3 Hys @ 300 mA. D.C. Resistance—50 ohms. An open clamp mounting (reversible) with leads

T.V. Voltage Adjusters



AVAILABLE IN BOTH AUTO WOUND AND DOUBLE WOUND MODELS WITH OR WITHOUT 0-250 v METER FITTED.

Designed primarily as aids to servicemen in installing and servicing television receivers, these Voltage adjuster units are now being used in other applications such as correction of input voltages to Amateur transmitting and receiving gear, tape recorders, Hi-Fi audio equipment, etc., where the load imposed is within the capacity of the adjusters.

AUTO MODEL TYPE: A.T. 1215 (illustrated)

Input voltage (50 cycle A.C.): 190, 195, 200, 205, 210, 220, 230 or 240, adjustable by means of tapping switch. Input connector: Bakelite 3-wire type enabling any convenient length of mains cord to be used. Output voltage: 200 to 240 as selected internally. Output power: 300 V.A. (maximum output current 1.3 A.) Output voltage indicator: 0-250V A.C. Meter (Optional). Output socket: standard 3-pin flush type. Weight including meter: 7¼lb.

DOUBLE WOUND MODEL TYPE: P.T. 1832

Input voltage: as for Auto model. Input connector: as for Auto model. Output voltage: 200, 230, 240 as selected internally. Output power: 200 V.A. (Maximum output current 0.8 A.) Output voltage indicator: as for Auto model. Output socket: standard 3-pin flush type. Weight including meter: 11lb.

FREE! Reference Folders, Pamphlets

Specification sheet and price list No. 2 has just been released. This handy reference folder gives full details of electrical specifications, physical dimensions (illustrated for easy reference) and prices of our standard range of power and audio transformers.

The various applications for the range of A & R voltage adjuster units are detailed in a fully descriptive, illustrated pamphlet now available.

Any of our distributors will be pleased to supply this literature on request.

ELECTRONIC A&R EQUIPMENT

A & R ELECTRONIC EQUIPMENT CO. PTY. LTD.,

378 St. Kilda Road, Melbourne. C.I. Victoria.

Stocks available from:—

N.S.W. AGENTS: R. H. Cunningham & Co., P/L., 16 Angas St., Meadow Bank.

VICTORIA: Homecrafts P/L., J. H. Magrath & Co. P/L., Radio Parts P/L., Warburton Franki, Motor Spares Ltd. **STH AUST.:** Gerard and Goodman Ltd., 196 Rundle St., Adelaide. **QLD.:** A. E. Harrold, 123 Charlotte St., Brisbane, Messrs. Chandlers P/L., Cnr. Albert and Charlotte Sts., Brisbane. **W. AUST.:** A. J. Wyle P/L., 1064 Hay St., Perth. **TAS.:** Homecrafts P/L., 220 Elizabeth St., Hobart. **N.S.W.:** United Radio Distributors P/L., 175 Phillip St., Sydney, Homecrafts P/L., 100 Clarence St., Sydney.

"nness" in an optical grinding m hine.

fter this, the slices are diced into sq ire wafers by ganged diamond saws. T square wafer of "doped" german- i is the heart of the transistor — a g nanium wafer about 3/10in square a one hundredth of an inch thick.

o make this germanium wafer into a ansistor two wafers of indium are a yed to each side of it in sandwich- li fashion.

his wafer sandwich, the transistor. is mounted onto a base onto which, i urn, is welded a stainless steel cup. I a special machine, a vacuum pulls o of this enclosing cup, damaging a iospheric components such as n isture.

hen a neutral gas is inserted in the c ed cup and it is hermetically sealed.

he modern high power transistor is aller and will handle more power t n the relatively high power vacuum es used in car and household radios, i contrast to the minute, match-head transistor frequently dramatised. se match-head size units will only ndle infinitesimal amounts of power.

The life expectancy of transistors has as yet been determined and ysicists hesitate to say what this ght be. They are confident, however, t transistors will provide many more rs of use than the more delicate uum tubes.

* * *

UNDERGROUND PETROL STORAGE

Faced with the problem of providing storage for over one million barrels of light petroleum products, the Esso Standard Oil Company of America has adopted a novel solution. It is proposed to scour huge cavities in a layer of natural rock salt which occurs at a depth of 2,000 ft. below a solid layer of impervious rock at Sorrento, Louisiana.

THE cavities are formed by drilling a borehole as far as the salt bed d then leaching out the soluble aterial with fresh water until the cal- lated amount of salt has been re- oved.

Petroleum gases in liquid form are en pumped in and float on the sur- ce of a brine layer. To remove the ored material more brine is pumped to displace the required volume, so iat the cavity is always kept full of iid.

Five such stores are projected, two f 150,000 barrels capacity, one of 00,000 barrels and two of 300,000 arrels. The smallest will measure ap- roximately 850 feet deep and some 35 et in diameter.

Rock salt cavity storage is eminently iitable for petroleum products because alt forms an excellent seal and will ot contaminate them.

Butane, propane, ethylene and propy- ene will be stored to even out the uctuations of supply and demand, and o meet the ever increasing call for thylene and propylene as raw materials or petro-chemical production.

A NEW 110-DEGREE CRT TUBE

The new 21CEP4 (right) has the same size screen as the conventional CRT (left).

The day when we suffered our T.V. tubes to project beyond the back edge of the cabinet may be numbered. This new design has reduced the length of a 21-inch by 6 inches with better quality and brightness.

NOW under regular production at the R.C.A. tube plant in Marion, Indiana, is the first commercial 110-degree picture tube in the 21-inch size, the 21CEP4.

Its appearance marks the culmination of efforts initiated as far back as 1952, when this manufacturer began to investigate the practical feasibility of increasing the deflection angle beyond 90 degrees.

By July, 1954, it was decided that an angle of 110 degrees was a realistic commercial objective; that is, a CRT deflecting through such an angle could be designed without requiring such alterations in associated circuits and components as to result in unrealistic receiver prices.

Little more than two years later, in October, 1956, the design now under production was incorporated in the 17BZ4.

The 21CEP4, weighing in at 22lb and measuring 14¾ inches long, incorporated several features developed over the years during which the project has been under way.

NECK DIAMETER

In addition to the determination that 110 degrees was the optimum angle, 1 1-8 inches had been selected some time ago as the optimum neck diameter.

Also, extensive work was done on determining the actual electron-beam paths in a picture tube, involving the use of some unique techniques. This research was necessary to arrive at the shape for the tube that would not obstruct the electron beam.

Out of these investigations came the parabolic contour presently associated with the new family of wide-angle cathode-ray tubes.

Other features found in the new line of picture tubes include a glass-button base, a straight electron gun that operates without an ion trap, and an aluminium backing on the screen of carefully controlled thickness.

The base of the tube combines the narrow pins used in miniature tubes with the plastic positioning key found on octal tubes. It should substantially reduce the number of otherwise usable picture tubes that must be replaced because of loose bases or poor base connections.

PRE-FOCUS LENS

In using a straight gun, although ion burn can be avoided with proper aluminisation, there is the additional danger of damage to the cathode with consequent shortening of tube life.

A unique pre-focus lens, which gives superior focus and definition and is relatively insensitive to voltage variations, avoids contamination.

In an extended life test 285 of the new tubes were subjected to 4,000 hours of use. Results indicate average emission life superior to that of conventional tubes.

Costs to the manufacturer for the 17- and 21-inch sizes range about two dollar more than for 90-degree tubes. Since only about 15 per cent. more deflectio power and " B plus" power are require from the receiver, no additional powe requirement is made on present conservatively designed sets.

A 24-inch version is planned for earl commercial availability.

A typical example of traffic "clovers and overpasses on the Hollywood-Sant Ana Freeway in California showin how the elimination of cross-section allows high-speed traffic to continu unimpeded. Once on the highway vehicles do not stop for anything. Thei destination reached, they "peel off to a "clover" or side road.

The New Science Of Traffic Control

The speed and volume of traffic along modern highways are creating tremendous problems for scientists and engineers. Europe and America have shown us how our own difficulties must be met if we are to avoid the complete saturation which threatens us. Our country is desperately in need of better ground communications.

by Calvin Walters

THIS new branch of engineering has been named Traffic Engineering, for it is entirely devoted to the study of traffic problems, and the improvement of the flow of traffic on highways and terminals. It is not to be confused with HIGHWAY ENGINEERING, which is the science of ROAD AND HIGHWAY CONSTRUCTION.

The fundamental aim of traffic engineering is to achieve the best traffic performance on existing roads by so applying scientific and engineering principles.

It aims to plan new roads and highways so that they will adequately cope with all traffic requirements at all times.

In short, traffic engineering attempts to provide a free flow of traffic with a minimum of accidents and casualties and congestion.

The traffic problems of almost every large city in Australia are most acute. This is because most cities were designed in days when the motor vehicle was never thought of. That such a vast increase in the use of motor vehicles, since their invention, could occur was not foreseen.

Today, almost every aspect of our lives is influenced by the flow of traffic on our roads.

The cost of living is directly affec by the congestion which exists on roa to and from cities. Wastage of m hours and fuel is enormous. This turn affects the growth of cities a retards development.

Traffic engineering begins with study of traffic characteristics, so th improvement of traffic performance existing roads can be brought about regulatory methods.

It collects facts relative to traffic erations, which are then analysed. Fr the analysis, a knowledge is gained all the diverse qualities of traffic und all conditions.

TRAFFIC ANALYSIS

The traffic on any highway is of very complex nature, for it involves su matters as human nature and the la of time, space and motion.

The driver and his vehicle is the ma unit in any traffic. Thus the ma characteristics of traffic involve t abilities, performance and the requi ments of both the human being as road user and the vehicle itself.

Other characteristics which have vital bearing on the study of traffic a speed, volume, origin and destinatic distance, direction of movement, int section flow and flow of the traf stream. The characteristics of accide are also studied because these are t indications or measure of failure.

As, therefore, the Traffic Engine must deal with the human element the road user, traffic engineering mu also cover the study of psycholog Likewise, because the vehicle is an i portant factor on the roads, the engine must study the physics relating to t behavior and performance of the ve icle.

Similarly, he must study the math matics required in analysis of statistic the detail of planning, the economics government and the theory of road a highway construction, including t physical nature of materials used ther for.

It will thus be seen that the scien of traffic engineering is a very compr hensive science requiring great skill an organisation of method.

It is impossible here to cover all t aspects of methods used by the traff engineer. Rather will we touch on som of the surprising and little known r sults of the study of highway traffic.

As the vehicle cannot use the roa without a driver, the latter is obvious

SPEED AND SAFETY IN CROSSINGS

th most important factor in highway pr lems.

he driver is activated with some pu ose. He is intent on going somew re either for business, social or re-cr tional purposes. He enters the traffi stream governed by five factors, n ely time, place, route, origin and d ination.

he behavior of the road user dep ds on his individual characteristics o ntelligence, skill, emotion and physi l condition.

s vision is the factor which, more th 1 any other, influences the road user t take certain action in his driving, t is the first consideration of the tr fic engineer.

Vhen a driver's eye is fixed on some p nt in front of him, the most acute v on is subtended by a cone with an a le of 3 degrees. Within this cone, v on is very distinct, but is also quite g d within a cone of 6 degrees and c y satisfactory up to an angle of 20 d rees.

RTICAL VISION

Vertically, acute vision is only from c half to two-thirds as efficient as it i in the horizontal plane and for any f d position it is better on the part of t retina nearest the nose.

For effective recognition by a driver i has been found that words and symb ls of traffic signs must fall within a area covered by the width of the h nd held at arm's length and in line w h the centre of the road. (T. M. Mats n). This is within a visual cone of a out 10 degrees.

The limitations imposed on the driver this restricted field of vision force n to shift his eyes about. Thus speed eye movement is important in direct oportion to the speed of traffic.

It has been found that, in order to t clear vision in highway traffic, the e must make six different kinds of ovements, which are all time consum-g.

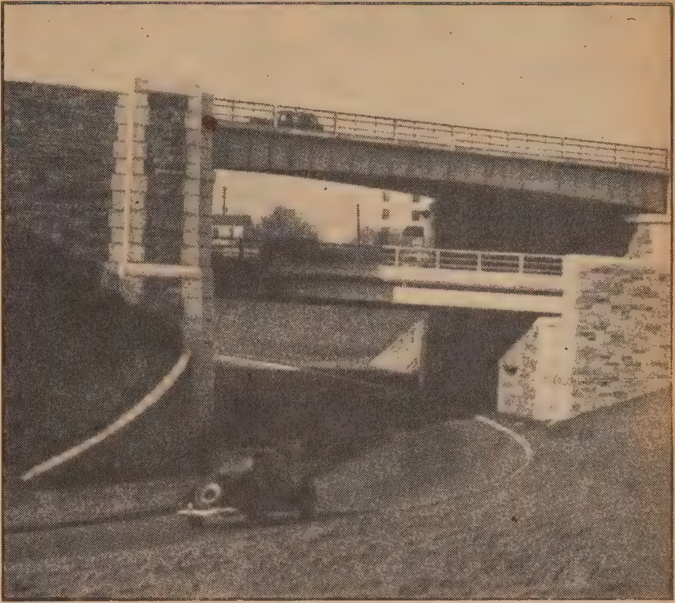
Firstly, the eye must fix on the ob-ctive. This takes about .17 seconds. en the eye jumps from one point to other. This can take up to .33 sec-ds if the stimulus is outside the field acute vision. Thirdly, the eye must llow the movements of other road ers. Then both eyes must move in rmony in order that the pupils may djust themselves to secure binocular sion on moving objects. This adjust-ent time can be up to .5 seconds. ifthly, the eye moves to adjust itself r movements of the head and, finally, oise and other stimuli often cause in-oluntary movements of the eye.

EACTION TIME

All these time-consuming movements e vital factors in the safety of the oad. If a driver fixes his eye to his ft at an intersection it can take him s much as one and a quarter seconds shift his eyes to the right and back gain to the left. This is time enough r anything to happen.

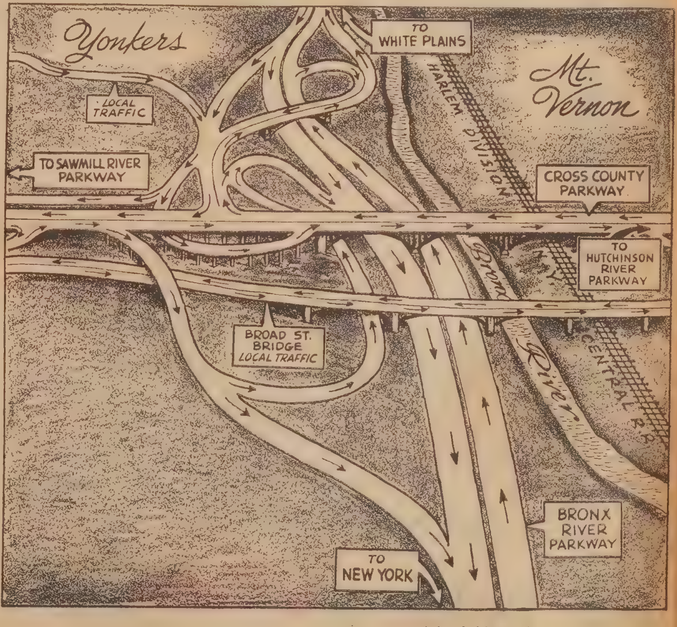
The figures mentioned do not take ito account the time required for re-ction, but are for seeing only.

According to K. Reid, a driver who driving with artificial illumination re-uires 1.3 seconds extra for each 10 niles an hour increase in speed to ob-ain maximum visual perception of traffic conditions. He loses, on an average, 20 feet loss of visibility for each 10 miles an hour increase in speed.



This three-level bridge on a busy highway outside Washington D.C. eliminates a dangerous corner and saves an enormous amount of time.

Everyone knows that one can see "out of the corner of the eye." This field of vision is called the Peripheral Field.



How a complicated highway system is planned. This one solved a hopeless traffic jam near New York.

LUSTRAPHONE FULL - VISION MICROPHONE

smooth styling . . hi-fidelit performance . . . and onl the size of a penny!

Model LFV59 (Low impedance) **LFV59Z (High impedance**
Fitted for table or stand use.
Diameter only 1½ inches!

- Frequency Response: Substantially fla to 14,000 cps.
- Impedance: 25 Ohms. 50,00 Ohms. Standard
- Design. Microphone Case handsomel finished in Silver Grey Hamme Flexible "Stayput" Tube permittin microphone to be tilted to desire position. Tube finished in Polishe Chrome. Microphone Case an Flexible Tube fitted with ½in x 2 TPI Standard thread for Floor o Table Stand mounting.

HI-FIDELITY SALES

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BX6651—BX5127

---

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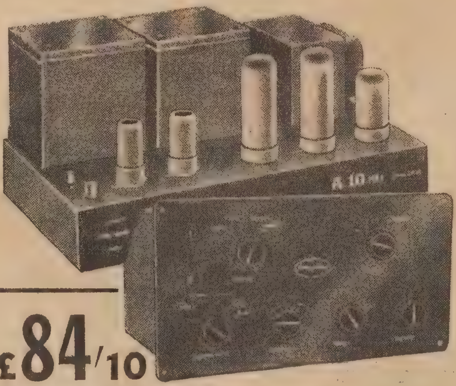

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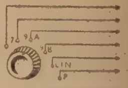
SPECIFICATIONS

NOMINAL OUTPUT RATING. 10 watts. Peak 20 watts.
INPUT TO MAIN AMPLIFIER FOR 10 watts: 80 MV.



VALVES

2 EL34 (push-pull output valves ultralinear connected)
EF86 (low noise pentode).
ECC85 (double triode).
GZ34 (rectifier).

Control Unit: ECC83 (double triode).
EQUALISER: 1, 78 (Old.); 2, FFRR, 78; 3, Brit. L.P.; 4, NARTB; 5, RIAA; 6, AES.

158 CLARENCE ST., SYDNEY
BX6651—BX5127

I this field, objects are not clear outsi the aforementioned 10 degree cone o acute vision. Rather does one merely d ern that something is there or going o You can, for instance, "see" someo getting off the footpath on to the r d. If you were to move your eyes to bring the object into the clear field o vision it would, including reaction ti e or the time taken to think, take a ut .5 of a second. It will take longer if ou also move your head.

he total "peripheral field of vision" o the two eyes varies in individuals f n 120 to 160 degrees. This shrinks t faster you go. It is about 100 deg es at 20 miles per hour, but drops t 40 degrees at 60 miles per hour. T us the faster the travel the less one c see "out of the corner" of the eyes.

OLORED LIGHTS

Traffic engineers therefore take this i consideration and do not rely on s e vision but on the field of acute v on when designing traffic regulations a l the position of signals. They see t t all traffic signs or signals are not s complicated that they require too g at a degree of visual concentration. The proper design of coloured traff lights takes into account the color b nd person's inability to distinguish b ween red and green. The inclusion o some yellow in the red light and b e in the green light assists the color b nd to distinguish the colors. The s ndard relative positions of the red, y low and green light is also of assista ce.

Traffic engineers take into account t e time required for the pupil of the e e to expand and contract according t the amount of light entering the eye. T ey found that the eye adapts itself m ch quicker when entering light from d rkness than when entering darkness f om light.

It will be appreciated that night drivi g imposes heavy demands on the eye b cause of variations in street illumina on, electric signs, glaring headlights a d so on. As the driver gets older a d if he wears spectacles, he finds it ore difficult to adapt his eyes to over me glare difficulties. Heavy cigar e smokers also sometimes suffer from is defect because of the iris of the es becoming partially paralysed by cotine.

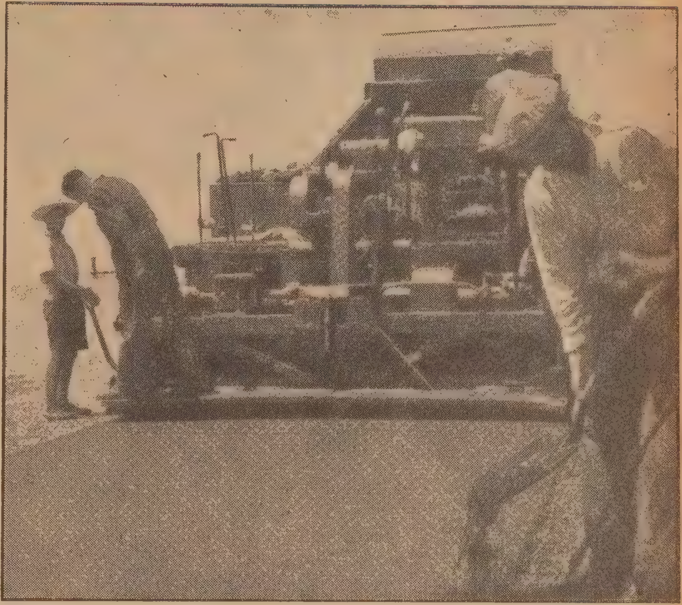
IEV TIME

What is your PIEV time? This is a w term coined by traffic engineers. ey find that every act that a road er performs is dependent on the excise of Perception, Intellection, Emo on and Volition, the first letters of ch of which spell PIEV. The total me taken for all these to act is the IEV time.

Sensations which are strong enough be recognised are called "percep ons." They may be received through e eyes, ears or the body. The time ken for the process to act on the ain is the perception time. It varies cording to the experience, psycholo cal and physiological characteristics f the individual.

The forming of new ideas based on evious experience coupled with new xperiences and the time taken for com aring, regrouping and registering for ter use is called intellection. It results in the sending of impulses over the nervous system to the glands and muscles. The recognition of an unusual hole in the road together with its comparison of another hole one encountered somewhere else and what one did about it and the difference between this one and the other is intellection. It acts quite unconsciously. The time taken for reaction is the intellection time.

MACHINES ARE KEY TO FAST WORK



Big road making machines such as this one apply and bake the road surface in a single operation. In the USA there are now machines several times this size which can lay down an entire concrete highway.

EFFECTS OF EMOTIONS

The emotional characteristics of the individual are an important factor in traffic. Fear or anger, as everyone knows, governs to a great extent the behavior of drivers in traffic.

Volition is the will to take some definite action and is the result of the resolution of all previous impulses into a decision to act.

PIEV time therefore is the total time for all the above to act so that a decision may be made. This time has been found to range from .5 seconds for simple problems such as to pull up in a certain position at a traffic light, to anything from 3 to 5 seconds for a more complex problem such as the decision to overtake another vehicle.

Fatigue lengthens PIEV time. This can be caused not only by physical weariness, but by glare, monotony and the effects of rhythm. Traffic engineers avoid monotony, rhythmic and glare sources when designing roads and lighting.

Any disease, or other disabilities such as deformities, alcohol and drugs increase PIEV time.

Climate, weather, altitude, time of day, season, ventilation, light and so on all have their effects on PIEV time. High temperatures and humidity cause high tempers and irritability, as also does the weather such as rain and snow. Mental and physical efficiency depend on the oxygen taken into the lungs and this depends on the amount of ventilation or the altitude. Colors of lights also have their effects. Variations in road surface such as alternating good and bad patches have effects on behavior.

Traffic engineers have found that, in almost every traffic situation, fear and self protection are the fundamental factors. Competition such as the "me first" attitude leads to anger and so on.

As the process of thought is "one thought at a time" traffic engineers try to place traffic signs so that the choice of the driver is limited to as few paths as possible, preferably to a single choice. This limitation of choice causes less frustration in complex traffic problems and leads to an easier flow of traffic.

CONDITIONING

There is one condition which often leads to accidents. This is known as "conditioned response." An example of this is the driver who, after travelling long distances at high speed, becomes what engineers call "velocitated." The driver will not reduce speed until some very strong stimulus forces him to do so, such as traffic entering a city or a sudden bad road.

Another example of this is the tendency, over a long drive, to follow some road marking or monotonous

Continued on Page 119

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Technical Review

NCHRONOUS SPOT WOBBLE IMPROVES DEFINITION

ritish engineers have always een interested in methods of mproving their 405-line T.V. lefinition. This article from Vireless World gives a new slant n an old idea with considerable promise.

discussions on British colour tele ision standards it has often been sug ested that a high-definition picture ight be transmitted in Bands IV or V n that standards conversion might be sed to obtain a 405-line version for ransmission to the existing 7 million nochrome sets.

uling out the "brute force" method of standards conversion (a camera "looking at a monitor tube) on grounds of picture degradation, the direct electronic system proposed by H. A. Fairhurst comes to mind.

his, and most other proposals tacitly assume that the high-definition picture will have a greater number of lines than he 405-line standard. There is, however, the interesting possibility that the high-definition picture might itself be 405 ines, but with increased resolution and bandwidth.

he normal-definition 405-line picture could then readily be extracted from it by sampling at a rate appropriate to a 3- c/s bandwidth.

his suggestion emerged from a lecture on a new system of television recording given recently to the British Kinematograph Society by A. E. Sarson and P. B. St k, with an historical introduction by .C. Jesty.

he new system is based on the well known suppressed-frame method of recording on film, but it avoids the loss of picture information normally associated with using only alternate television frames by starting off with a 405-line picture of high definition.

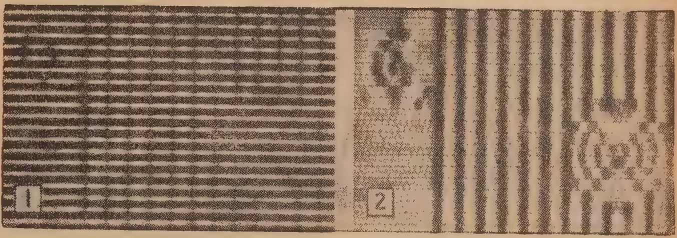
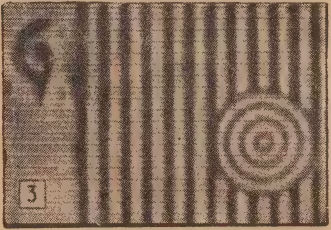


Fig. 1 shows a section of a test chart on one frame of a 405-line picture (202½ lines) without spot wobble. Fig. 2 is the same section with ordinary spot wobble applied to the c.r.t., while Fig. 3 (below) shows the improvement effected by synchronous spot wobble on both c.r.t. and camera tube. A complete interlaced picture with s.s.w. is even better.

he 202½-line television frames recorded on successive film frames then contain much more information than they would with the normal definition, and when subsequently the film is scanned for transmission a much better picture is obtained.

Of course, since the camera chain giving the high definition picture for recording is also the means of producing the "live" program, a 405-line picture of normal definition has to be extracted for transmission, and this is where the sampling process is used.



The increase of definition without extra lines is obtained by a technique known as synchronous spot wobble. With ordinary spot wobble the idea is simply to fill in the spaces between the lines, and this is particularly necessary on suppressed-frame recording where each film frame records only 202½ lines and there is no subsequent interlacing.

As an example, Fig. 1 shows a section of a 202½-line frame and Fig. 2 how it is improved when ordinary spot wobble is applied to the c.r.t. The main drawback of ordinary spot wobble, however, is that it displaces picture information which should appear at only one point on the screen so that it also appears at other points. This produces among other things a stepped effect when diagonal or curved lines are scanned, as shown in Figs. 2 and 4, with consequent deterioration of picture quality.

With synchronous spot wobble, however, these effects are avoided. The alternating wobble voltage is applied to the camera pick-up tube as well as to the monitor c.r. tube, and is synchronised in frequency and phase at both ends.

The result is that the scanning spot has an increased path length and covers a greater area of picture detail than normal during the period of one line. Because of this higher scanning speed, information is transmitted through the closed-circuit system at a higher rate than normal, so that a larger bandwidth is required.

In addition to filling in the spaces between the lines, the synchronous spot wobble gives a vertical "exploratory" component to the horizontal scan, with the result that the vertical resolution of the complete picture is increased. Actually the spot-wobble scanning is such

(Continued on Page 27)

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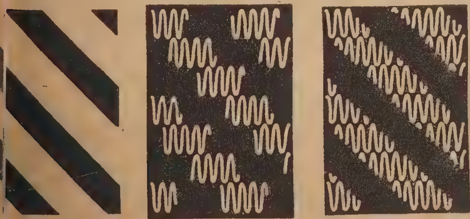


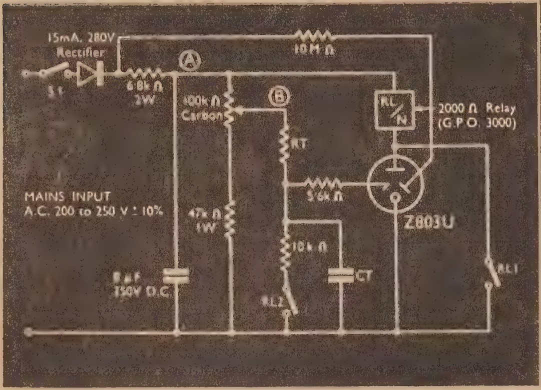
Fig 4. When scanning diagonal bars (left) ordinary spot wobble gives a stepped effect (centre) but synchronous spot wobble fills in the spaces with genuine picture information (right).

FOR TIMER SIMPLICITY AND ACCURACY.

Z803U

TRIGGER TUBE

Mullard
Z803



The Z803U trigger tube can be used for a variety of timer, voltage control and general relay applications. It has an extremely stable trigger voltage over a very long operating life and offers the advantages of all Mullard cold cathode tubes — no heater supply requirements, no waiting for "warming-up" and good mechanical strength.

Typical of the applications of the Z803U is the simple interval timer described here which can cover the range between 5 seconds and 10 minutes. It may be operated direct from any a.c. mains supply between 200 and 250 volts.

To start a timing sequence the mains supply is switched on (S1). The d.c. voltage at point A will then rise, in about 100 milliseconds, to between 184 and 282 volts, the actual level depending on the value of the local mains voltage. The timer capacitor CT will start to charge up through RT, the timer resistor.

When the voltage on CT reaches the critical trigger voltage of the Z803U the tube will fire, pulling in the relay, partially discharging the 8 microfarad smoothing capacitor, and lowering the voltage at A.

The relay will self lock on contact RL1 thus extinguishing the Z803U, and the relay current will then be limited by the 6.8 k Ω series resistor. Contact RL2, which should make after RL1, re-sets the timer capacitor to zero volts.

However, the relay drops out only when S1 is opened. A new sequence can then be started on reclosing S1.

The 100kΩ preset potentiometer allows the timing circuit voltage to be set up so as to compensate both for component tolerances and for the value of the local supply voltage. The pre-firing voltage at point B will be about 170 volts.

The values of RT and CT will be set by the required time interval T′, and can be determined from the fact that T′ — 1.6 RT.CT.

RT should be a high stability resistor, while CT must be a capacitor with a small power factor, e.g., a paper or plastic film capacitor. All other components are of ± 10% tolerance.

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RADIO PILL BROADCASTS FROM YOUR STOMACH

"RADIO PILL," an encapsulated FM transmitter that n be swallowed and is used to elemeter" information from te digestive tract, was demonrated recently at the Rockeller Institute in New York ty. Its action was explained by r. Vladimir K. Zworykin, affilte in biophysics in the Medical ectronics Centre of the Rockeller Institute and honorary ce president of RCA, who had en active in the early stages its design.

A "radio pill" offers the medical man any possibilities since it causes no dismfort to the patient and thus can make easurements under more normal conions than older tools.

It can easily penetrate such areas as e right side of the colon, hitherto most inaccessible to study.

RESSURE MEASUREMENT

Present models (only three were in istence at the time of the demonration) have been used to measure essure. Temperature measurements e also possible, and it is expected that eans will be devised to measure acidity the gastro-intestinal tract.

The transmitter consists of a ferrite ıp core, two coils, two resistors, two apacitors, a transistor, and a small rehargeable 1.5-volt cell in a plastic caple 1 1/8 inches long and 0.4 inch in iameter.

Operation is at approximately 1 mc, nd the signal is receivable for a foot or wo outside the body.

The unit is frequency-modulated by disc-shaped magnetic shunt, which hanges the inductance of the core as t moves closer and farther away. Since requency modulation is used, changes n amplitude caused by the unit moving earer to or away from the body's surace create no reception problems.

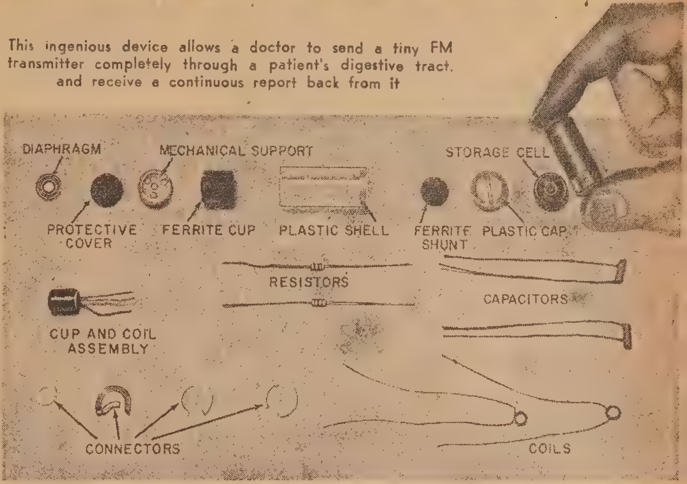
THE TRANSDUCER

The pressure transducer consists of a rubber diaphragm (a metal diaphragm was used in the first model, shown in exploded form in the photograph) to which the magnetic shunt is attached.

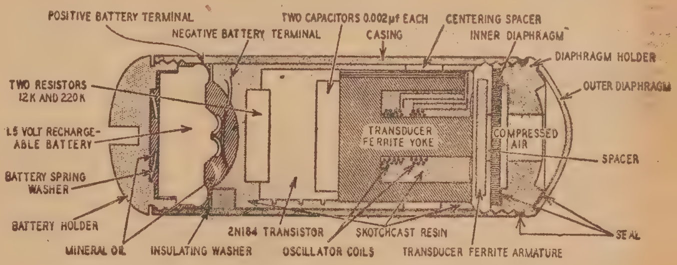
As pressure is increased, the diaphragm is bent inward, forcing the shunt nearer to the core and lowering the transmitter's frequency. A second diaphragm is provided at the end of the tube, for mechanical protection.

The space between the two is filled with air, under enough pressure to make the whole space act as a piston, transmitting the pressure from one diaphragm to the other without significant loss.

The idea of such a pill was conceived by John T. Farrar of the Rockefeller Institute and its design worked out by Dr. Zworykin. The development work was done by a team of engineers of RCA's Commercial Electronics Products Division in Camden, N.J.


This ingenious device allows a doctor to send a tiny FM transmitter completely through a patient's digestive tract, and receive a continuous report back from it
DIAPHRAGM
MECHANICAL SUPPORT
STORAGE CELL
PROTECTIVE COVER
FERRITE CUP
PLASTIC SHELL
FERRITE SHUNT
PLASTIC CAP
RESISTORS
CAPACITORS
CUP AND COIL ASSEMBLY
CONNECTORS
COILS

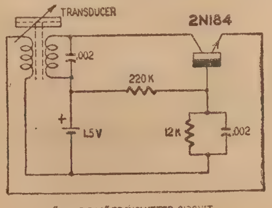
These components all go together to make up the 0.4 inch diameter $1\frac{1}{8}$ inch long. Radio Pill that telemeters information from the digestive tract.


POSITIVE BATTERY TERMINAL
NEGATIVE BATTERY TERMINAL
TWO CAPACITORS 0.002µf EACH
CASING
CENTERING SPACER
INNER DIAPHRAGM
DIAPHRAGM HOLDER
OUTER DIAPHRAGM
TWO RESISTORS 12K AND 220K
1.5 VOLT RECHARGEABLE BATTERY
TRANSDUCER FERRITE YOKE
COMPRESSED AIR
SPACER
BATTERY SPRING WASHER
BATTERY HOLDER
2N184 TRANSISTOR
SKOTCHCAST RESIN
SEAL
MINERAL OIL
INSULATING WASHER
OSCILLATOR COILS
TRANSDUCER FERRITE ARMATURE

Cross-section diagram of the capsule containing the FM transmitter.

A remarkable feature of the apparatus is that it was constructed from available miniature components. Even the battery was found on the market. The constructors did not have time to get special components made for the job and had to rely on standard parts. With specially made components, an even smaller capsule could be built.

In its present stage of development, the radio pill must be considered an experimental technique but one which holds important implications for future medical research. The pill's practical uses will be evaluated following laboratory tests and experiments.


TRANSDUCER
2N184
.002
220 K
1.5V
12K
.002

"RADIO PILL" TRANSMITTER CIRCUIT

Circuit of the transmitter.

Studies involving use of the radio pill, for the time being at least, are being carried out in the New York Veterans Hospital with the patient under continuous observation. Preliminary testing has taken place during the last year.

—RADIO ELECTRONICS.

INVISIBLE ANTENNA

AN American company has acquired patent rights to an antenna that has no towers, rods or wires.

The antenna is actually a long column of ionised air produced by an x-ray tube or by radioactive elements such as uranium or radium.

The shaft of charged atoms serves as a conductor and can receive or transmit high-frequency signals.

Because of the power and equipment needed, the invisible antenna probably will be used in industry rather than on household television or radio.

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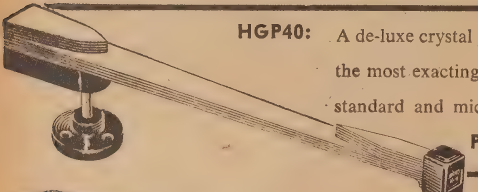

HGP40: A de-luxe crystal pick-up to satisfy the most exacting. Complete with standard and microgroove heads.

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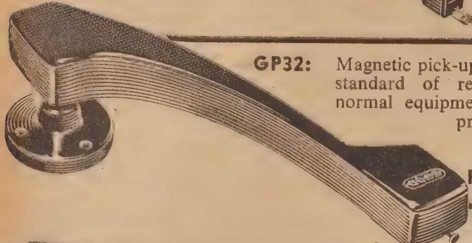
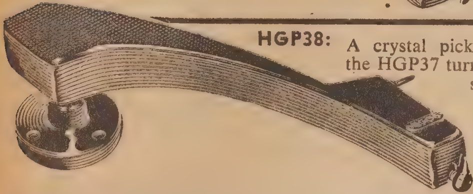


GP32: Magnetic pick-up provides a good standard of reproduction with normal equipment at reasonable price. Output voltage, ½ volt at 1,000 c.p.s.

PRICE, £2/12/6

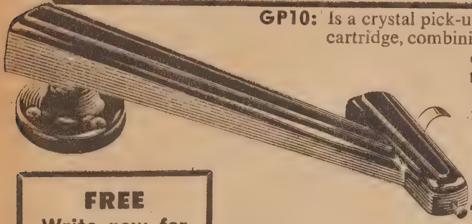


HGP38: A crystal pick-up. Incorporates the HGP37 turnover cartridge for standard or microgroove recordings with cantilever stylus.

PRICE, £5/15/-

GP50: Is a HIGH-OUTPUT crystal pick-up suitable for reproducing standard and microgroove records through *low-gain* amplifiers as used in small record players and some radios. **PRICE, £4/19/6**

GP60: Incorporates the latest-type CERAMIC cartridge—unaffected by heat or humidity. For use in tropical areas. **PRICE, £6/16/-**



GP10: Is a crystal pick-up utilising the GP9 cartridge, combining purity of reproduction with extreme reliability. Resonance-free response from 50/8,000 c.p.s. Output, 1.5V at 1,000 c.p.s.

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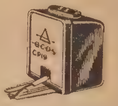
plus these acos replacement cartridges

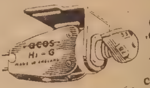


HGP39 CARTRIDGE

Designed to meet the most exacting requirements of modern recordings — low element mass and very high compliance enables the heaviest modulation possible to be traced with a minimum of record wear. Both standard and L.P. heads available. **PRICE, £3/12/6**

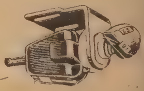
GP9 CARTRIDGE

Now famous as the cartridge with the unbreakable crystal. Takes standard steel or fibre needles for 78 r.p.m. records. **PRICE, £1/11/6**



GP59 CARTRIDGE

A HIGH-OUTPUT cartridge suitable for reproducing standard and microgroove records through low-gain amplifiers. **PRICE, £2/3/-.**



CARTRIDGE GP61

A CERAMIC cartridge that will withstand the rigours of a tropical climate and is, at the same time, very robust. **PRICE, £3/19/6**

HGP37 CARTRIDGE

A TURNOVER cartridge with cantilever stylus that utilises a new method of crystal drive, a bisectional control element that achieves independent characteristics for standard and microgroove. **PRICE, £2/18/6**

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NEW LONG LIFE T.V. RECTIFIER

The first line of germanium rectifiers specifically designed for T.V. power supplies is being incorporated in new T.V. receivers just reaching the market or about to reach the market in the U.S.A. The new semiconductor units are being produced in quantity, at prices competitive with selenium rectifiers.

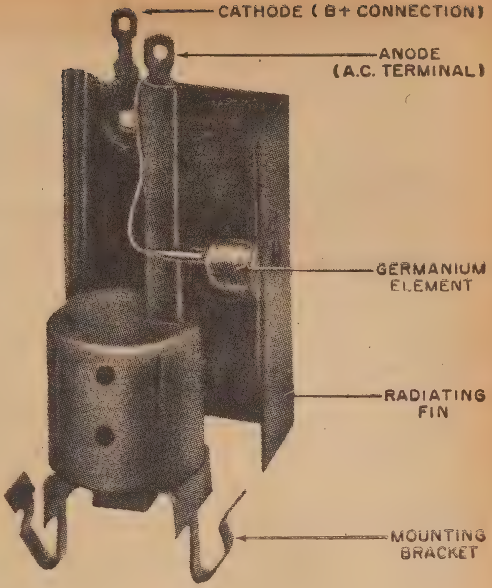

Fig. 1: The 1N573 germanium rectifier is shown here almost twice actual size

☆

EQUALLY as important as the news that these units are being incorporated in original equipment is this following announcement: these germanium power diodes are also being made available in a form that will permit use as replacements for the more conventional selenium diodes found in countless receivers already in use.

There is nothing new in using germanium as the element in a crystal rectifier. Historically, this material antedates selenium in such a role.

Also, it has been known to enjoy certain advantages over selenium. However, until recently developed production techniques cut back the cost of manufacture sharply, germanium rectifiers could not be made available at the voltage and current ratings required for use in T.V. and radio power applications except at prohibitive prices. These new units are competitively priced.

The first three rectifiers to appear in the line are RETMA types 1N573, 1N575 and 1N581. The first is a half-wave unit that delivers 250 ma. of d.c. output. The 1N575, also a half-wave rectifier, is designed for a 350-ma. output. The 1N581, consisting of two rectifiers already connected in a voltage-doubler configuration, is rated at 250 ma.

LOW VOLTAGE DROP

Full-cycle average full-load voltage drop for these devices is very low: a maximum of .15 volt for the 1N573 or the 1N581 and a maximum of .3 volt for the 1N575. Maximum peak inverse voltage ratings of 380 volts apply to all three. Also, each of them is designed to be used with a 4-ohm surge-limiting resistor. The units are hermetically sealed in metal cases and are warranted for one year.

Physically the units are smaller and lighter than their selenium counterparts and, even at the small size of the entire unit (see Fig. 1) most of it consists of a radiating surface or heat sink and a mounting bracket. The actual germanium element is much smaller than a dime.

On the rectifiers being supplied to set manufacturers the mounting bracket is a mechanical snap-in type to keep chassis assembly costs down and also to streamline later replacement. The types being produced for field replacement of selenium rectifiers are electrically identical to these but have brackets that will permit direct mounting, where conventional selenium devises were used, without any physical alteration.

In germanium rectifiers, as in the silicon rectifiers introduced more than a year ago, there are only the crystals of a single element to deal with, rectification taking place within this element rather than at a junction. It is therefore much easier to control production of germanium rectifiers.

No circuits for germanium-diode power supplies are shown because these configurations are entirely familiar; they are identical with supplies using selenium rectifiers.

Load capacitors in the filter circuits used for the germanium devices are recommended to be in the range from 100 to 300 uFd. Where selenium-to-germanium replacements are being made clearly no changes are needed here.

The 4-ohm minimum value for the surge-limiting resistor required for any of the germanium units now available is less than that required for comparable selenium rectifiers, so there will not usually be changes in this item—except where the technician may wish to take advantage of the slightly higher "B plus" made possible.

Typical voltage-regulation curves, shown in Fig. 2 for a 1N573 germanium diode with various values for the capacitive load, tell an interesting story when compared to a curve for a comparable selenium unit.

With the lower internal voltage drop the germanium rectifier begins by yielding a greater output voltage to the external circuit and, as drain by the circuit is increased, voltage output from the germanium power supply holds up much better.

To the service technician the switch to a germanium rectifier means a convenient solution to many elusive problems where critical operation is associated with marginal "B plus" supplies or drops in line voltage.

To the set owner, the high reliability of germanium rectifiers and the long life that may be expected of them will be welcome. The new units are expected to outlast their receivers.

Since selenium rectifiers age with use, showing decreased output as time goes on, they have to be derated for use in equipment.

This is to say that when a unit is being selected for use in a particular

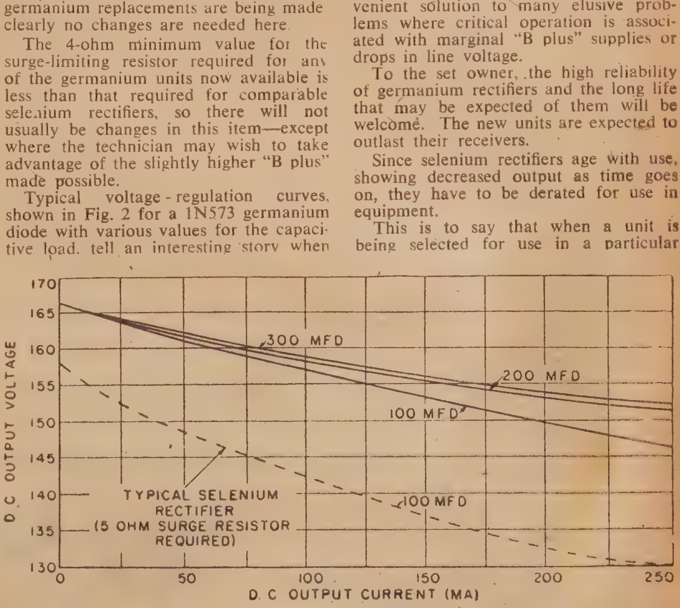

Fig. 2: Typical voltage regulation curves for the 1N573 germanium rectifier when used in a half-wave circuit with capacitive load, for three values of capacitance. A comparable curve for a selenium rectifier is also included.

TEST EQUIPMENT *from "Audio Engineers'*

Oscilloscope Model 32A

This is a versatile Oscilloscope primarily intended for T.V. and Radi Service work, but having outstanding performance and many feature which make it invaluable for general purpose use wherever an Oscillo scope is required. It has a 4in flat faced C.R. Tube.

We carry stocks of test equipment Specially for Television Service

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M.B.H. 12in Arm c/w 1 head	14	15	5
M.B.H. 14in Arm c/w 1 head	16	0	4
M.B.H. 16in Arm c/w 1 head	17	18	6
M.B.H. LP or Std head c/w sapphire stylus	8	13	5
M.B.H. LP or Std head c/w diamond stylus	18	5	8
M.B.H. Low impedance heads available.			
M.B.H. Sapphire Styli LP tubes of 5	1	17	1
M.B.H. Sapphire Styli Std tubes of 2		14	10
M.B.H. Diamond Stylus	9	19	10
Leak 12in Arm	6	8	3
Leak LP or Std Heads Diamond Stylus	13	8	1
Leak Matching Transformer	4	2	0

ORTOFON

16in Arm Model RK309	24	7	11
16in Arm Model RF309	34	2	3
12in Arm Model SK212	9	18	3
LP or Std Type "A" Heads	24	14	7
LP or Std Type "B" Heads	33	5	0
LP or Std Type "C" Heads	37	19	9
Matching Transformers	5	9	4
Goldring Transcription Arm only	7	10	0
Goldring 555 V.R. Cartridge	6	0	0

AMPLIFIERS

RCA Orthophonic	139	10	0
Leak TL25	144	6	7
Leak TL12	121	16	0
Leak TL10	74	11	0
Quad Mark II	113	12	6
Trixonic 800	73	12	0
Aegis Mullard 5-10	55	4	0
Grampian Mulard 5-10	51	9	0

THE NEW E53 NPA THORENS PRECISION TURNTABLE

Price £35/1/10.

- ★ 12in Cast aluminium turntable precisely machined.
- ★ Airmoil rubber foam cover.
- ★ Thick aluminium base plate.
- ★ Flutter and wow within high fidelity specification.

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Goodmans Axiette	15	1	0
Goodmans Axiom 150 Mark II	28	7	6
Goodmans Axiom 22 Mark II	42	17	6
Goodmans Axiom 80	35	16	6
Wharfedale Super 12CS/AL	44	3	7
Wharfedale W12/CS	25	1	9
Rola 12UX Hi Fi	28	19	5
Goodmans "Trebax" Tweeter	11	19	3
Goodmans "Midax" Mid. range	26	5	0
Leak "Duad" 15in Twin	53	12	6
Jensen Co-axial	17	12	3
Kelly Ribbon Tweeter	30	9	5
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Goodmans Acoustic Resistance Units			
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Model 180	7	5	0

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Fidelity AE Audio Engineers PTY. LTD.

of equipment it is chosen to be sized in the electrical sense, so that ll still be useful in the circuit as its l capacity to deliver voltage and ent falls off.

nce there is no aging problem with anium rectifiers a germanium unit is used to replace a selenium unit safely have a lower nominal rating n actual example of this difference ating for comparable units is taking e in current G-E production of its of 17-inch portable T.V. receivers he original circuit called for a pair elenium diodes rated at 300 ma. each ver models use a pair of germanium s rated at 250 ma. each. For the nician planning a substitution; the bet is to measure current drain on rectifiers to decide on the current ng of the replacement unit rather n to use the rating of the selenium ice as a guide.

s for testing when a defective recti- is suspected, the procedure is similar but simpler than, that used for a nium unit. Forward and reverse stance readings. taken directly across diode with an ohm-meter, are com ed, but no critical readings are given standards.

Aging or loss of efficiency do not cur with germanium rectifiers. A short he only type of defect that can occur. erefore, if resistance readings taken in th directions are low, the unit is rted and should be discarded. In all her cases the rectifier may be con- ered as still good.

YNCHRONOUS SPOT WOBBLE IMPROVES DEFINITION

(Continued from Page 21)

at the improved definition is shared etween the vertical and horizontal rections.

Fig. 4 (right) shows diagrammatically ow the scanning of diagonal bars is improved by the use of synchronous spot obble, while Fig. 3 demonstrates it on n actual screen picture of the section f chart in Figs. 1 and 2.

Instead of just filling in the gaps between lines with spurious picture information, as with ordinary spot wobble, the ew system adds genuine information which was previously missing. Of course, the price to be paid for the improvement is the increased bandwidth, but this does not matter in the closed-circuit system used for recording purposes.

A spot-wobble frequency of 6 Mc/s has been found satisfactory, and this demands a video bandwidth of at least 6 Mc/s and preferably 9 Mc/s. In practice the spot-wobble scan produces the effect of a 6 Mc/s sub-carrier on the video signal, which is modulated by the line sync waveform and the picture information to form sidebands extending up to 3 Mc/s on either side.

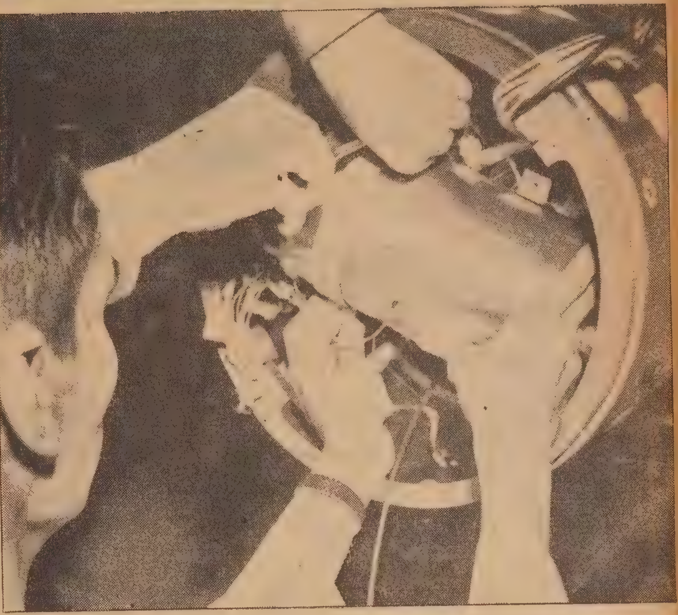
To extract the "live" television picture from the high-definition closed circuit for transmission at normal 3 Mc/s definition, a sampling p.r.f. of 6 Mc/s is required (according to the well-known Hartley law). If the samples are of sufficiently short duration, and they are smoothed afterwards by passage through a 3-Mc/s low-pass filter, the "contaminating" effect of the vertical component in the synchronous spot wobble is removed and the resulting picture is practically indistinguishable from one generated in the normal way.

Of course, if the high definition 405-line picture were actually transmitted in a wideband public service, instead of just being confined to a recording closed circuit, some means would have to be adopted for synchronising the spot wobble in the domestic receivers with that at the studio camera.

Probably this could be achieved by transmitting a "burst" of several cycles of spot-wobble frequency as a phasing signal on the back porch of the existing line sync pulse—as is already done in the N.T.S.C. colour television system. (In fact, the "burst" might easily serve a double purpose in a 405-line high-definition colour service.)

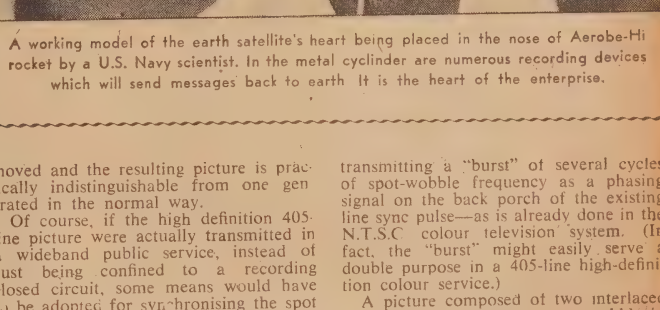
A picture composed of two interlaced frames with synchronous spot wobble is, of course, a good deal better than the single frame in Fig. 3.

HEART OF AN EARTH SATELLITE



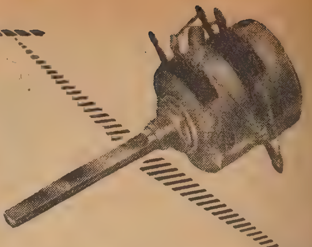
A working model of the earth satellite's heart being placed in the nose of Aerobe-Hi rocket by a U.S. Navy scientist. In the metal cyclinder are numerous recording devices which will send messages back to earth. It is the heart of the enterprise.

NEW ELONGATED SPEAKER DESIGNED FOR T.V.



This unusual loudspeaker made by Rola (U.S.A.) measures 14 x 3 inches and is intended for front mounting in T.V. cabinets. Performance is claimed equal to that of a standard 8-inch speaker and comparable with many 10-inch types.

IRC
AUSTRALIA



FIT New type LB1 Continuously Compensated Variable LOUDNESS CONTROL TO YOUR RADIO OR AMPLIFIER

...and automatically keep the proper balance of all frequencies within the audio range at ANY listening level!

(Patent Applied for No. N11262)

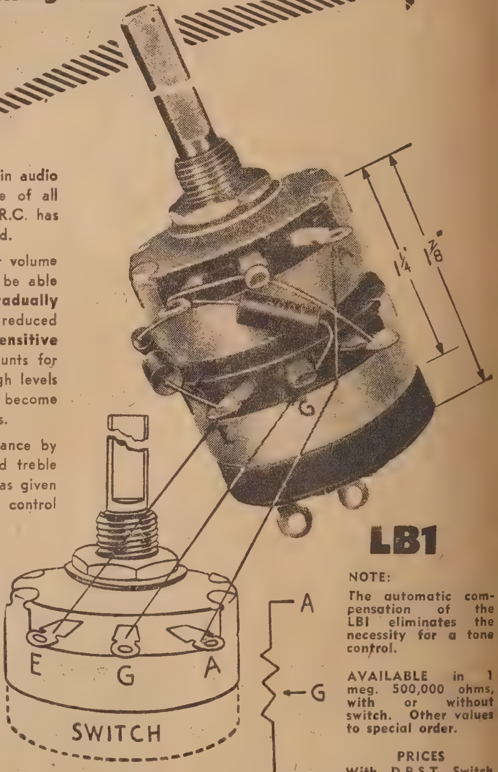
For many years there has been a need for a volume control in audio systems which would automatically keep the proper balance of all frequencies within the audio range at **any** listening level. I.R.C. has developed such a control, known as the LB1, to meet this need.

With the loudness control it is possible to reduce the output volume of any good or average audio system to a whisper and still be able to hear every tone with perfect balance, as the LB1 **provides gradually increasing high and low frequency boost** as the volume is reduced to offset the deficiencies of the human ear, **which is insensitive to high and low frequencies at low volume.** This accounts for the reason why many audio systems are operated at such high levels to give the best listening effect and in this process they become annoying to other members of the household and neighbours.

Many attempts have been made to obtain correct tonal balance by means of tapped volume controls, various types of bass and treble boost circuits and stepped type loudness controls, but none has given the performance of a truly continuously variable loudness control such as the new I.R.C. LB1.

The I.R.C. new loudness control consists of two separate volume controls operated from a single shaft of standard size and used with a combination of capacitors and resistors which are already wired. The unit will replace any volume control by transposing 3 simple connections, as indicated by the illustration at right. Can be fitted without experience.

Contact your usual supplier for illustrated literature.



LB1

PRESENT VOLUME CONTROL

NOTE:
The automatic compensation of the LB1 eliminates the necessity for a tone control.

AVAILABLE in 1 meg. 500,000 ohms, with or without switch. Other values to special order.

PRICES
With D.P.S.T. Switch 32/6; Without Switch 26/6.
Available only from your usual supplier.

Post this coupon today!

Please forward Loudness Control pamphlet giving detailed description and installation instructions.

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SUPPLIER (optional) .... JULY

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126 SUSSEX STREET, SYDNEY • BX 1131
(50 yards from King St.)

NEWS AND VIEWS OF THE MONTH

New gear for airports

SYDNEY and Melbourne will soon have extra radar facilities to help em handle air traffic more quickly.

The equipment, known as surveillance dar, will allow one man to handle up 26 aircraft per hour.

The present rate is 19 aircraft per ur.

The new equipment will reduce the ne required to handle each aircraft it takes off or comes in for landing.

It will be fitted with a screen which ill display all the aircraft within the proach area at the one time, covering radius of 20 miles from the landing ld.

The new equipment, which is made in ngland, will probably be installed with- 18 months. Its estimated cost is 60,000.

New alpine tunnel

BY agreement between the Governments of Italy and France, a tunnel to be built under Mt. Blanc, 11 miles length, to provide an all-weather route rough Switzerland between the two untries.

At the present time the road over the wiss Alps is dangerous and impassable r most of the year.

Cars have to travel part of the way n railway flatcars through the existing implon Tunnel.

When the new tunnel is finished it is stimated that at least 300,000 vehicles er year will use it. France will pay more than half the cost, Italy most of the rest and Switzerland the remainder.

Total cost will be about £15 million.

Radar auto brake

IN Chicago an automatic brake for motor cars, operating on a radar principle, has been developed.

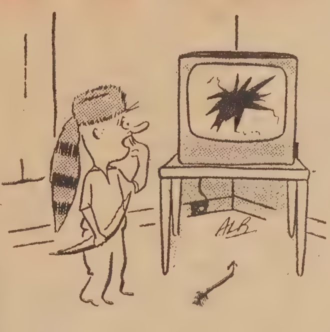
An experimental vehicle equipped with the device — an antenna mounted in front — passed recent tests.

As obstacles or vehicles approached brakes were effectively applied before the driver touched the brake pedal.

Robert Moore, director of the technical and engineering division of Lumberman's Mutual Casualty Co., said:

"If all automobiles were so equipped head-on collisions of cars travelling at reasonable rates of speed might be impossible.

"Tail gating, or following the car ahead of you too closely — a leading cause of rear-end collisions — also would be eliminated."



Daddy! I've killed Robin Hood!
— T.V. Times

Atom powered navies

BRITAIN'S Navy of the future is likely to consist of task forces each with a carrier armed with atomic planes and weapons, a cruiser, destroyers and frigates.

Parliamentary Secretary to the Admiralty Christopher Soames says that, while such forces would be employed in the most advantageous manner around the world, they would also be capable of concentrating at any given point.

A force of destroyers and frigates mothered by a cruiser could effectively control the sea.

By 1966 the U.S. plans to have six 85,000-ton nuclear-powered aircraft-carriers in service.

The first is due to be ready in 1961.

The Navy attaches so much importance to the "super-carrier" that it is willing to sacrifice several smaller ships in the building program.

The atom-driven giants will be as large as the biggest liners afloat to-day.

POPULAR SCIENCE QUIZ

Q: What is cryogenics?

Cryogenics is a growing branch of science concerned with extremely low temperatures and particularly the behaviour of gases at these extremely low temperatures.

Hydrogen and nitrogen for example go from a gaseous state to liquid at temperatures in the vicinity of 300 degrees below zero Fahrenheit.

Q: What happens to gases when they are cooled to these very low temperatures?

In general, they change from a gaseous to a solid state. In the liquid state they can exhibit some extraordinary properties. Helium gas, for example, turns into two different liquids at very low temperatures. One of these liquids mysteriously creeps and crawls out of its container.

Q: How are gases liquefied?

Various methods are used, some being too involved to describe in detail. The Hampson liquefier which is often used industrially to liquefy air makes use of a compressor which pumps air through a nozzle via a heat exchanger. As the gas expands through the nozzle it cools. Some of the cool gas is returned through the heat exchanger where it cools the incoming high pressure gas. The cooling process continues until very low temperatures are reached.

After a short time of operation some of the air liquefies as it leaves the expansion nozzle and falls into a vacuum flask after which it can be drawn off into vacuum bottles for storage.

Q: What are the uses of supercooled liquids?

Many of the uses probably have not yet been discovered, but the physical effects are startling and worthwhile uses for them will no doubt be found. At low temperatures, rubber becomes very brittle and will shatter if dropped. Steel becomes very hard but as brittle as glass. Lead sheet rings like a bell when struck while it carries electric current far more easily than silver which is one of the best conductors at ordinary temperatures.

Much in the same way as heat treatment improves the properties of certain steels, cold treatment can improve the durability of tool steels and improve special properties of magnetic steel. In certain assemblies, parts can be fitted easier if they are shrunk by cold first.

Liquefied gases are sometimes used instead of explosives particularly in coal mines where nitrous gases pollute the air. Containers of liquefied gases are placed in appropriate places and, when the explosion is required, quickly heated up. The liquid boils with an explosive force which is "softer" in character than most explosions and useful for some purposes.

Q: What are the electrical effects of these low temperatures?

One of the most interesting effects is the reduction of electrical resistance. It was investigated by Onnes in 1911 when he found that the resistivity of pure mercury dropped to zero at about minus 270 degrees centigrade. The same effect occurs with other conductors and it may be in the future some practical use will be able to be made of super-conductivity, as the phenomenon is called, to reduce losses in electrical circuits.

There is also a relation between magnetism and the behaviour of substances at very low temperatures and many interesting and useful effects will no doubt be discovered as scientific investigation is made in this field.

PHILIPS SOUND EQUIPMENT

the "Key" to better sound

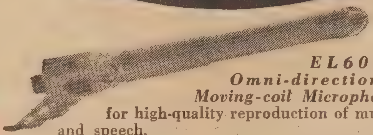
Philips sound equipment is designed for maximum field performance and can be tailored to meet your individual needs.

For applications ranging from industry and commerce to satisfying home entertainment the "key to better sound" is Philips equipment.

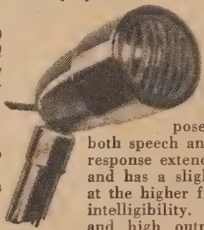
The Microphone

Philips range of microphones includes models from all-purpose crystal to the highest-quality condenser and dynamic microphones.

Two popular examples are—



EL6040 Omni-directional Moving-coil Microphone
for high-quality reproduction of music and speech.
Maximum diameter: $1\frac{1}{8}$". Overall length: $10\frac{5}{8}$". Net weight: 12 ozs.
Frequency response: Flat from 30 c/s to 20 Kc/s.
Impedance variable: 25,000 ohms, 500 ohms or 50 ohms.



1114 (Low Impedance) and 1115 (H.Z.) Omni-directional Moving-coil Microphone.

This is a general-purpose microphone suitable for both speech and music. The frequency response extends to above 10,000 cycles and has a slightly rising characteristic at the higher frequencies for improved intelligibility. Its robust construction and high output make it admirably suited for tape recorders and public address purposes.

Sound Amplification

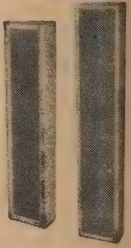
The Philips standard range of amplifiers, booster-amplifiers and tuners extends from 2 watts to 120 watts.

Pictured is the 30-watt amplifier, whose many features are typical of the range.

It has separate bass and treble controls, separate microphone and pick-up gain controls and selection of output impedances. Suitable for operation from mains voltages between 110 V-260 V, 40-60 cycles.

Sound Distribution

The Philips range of speakers and speaker enclosures is extensive and includes such units as flush ceiling fittings, wall enclosures in metals, plastic and timber, bass reflex units, flares and horns. Featured are the types 1065/1070 sound columns. These remarkable units offer pre-calculated distribution of sound as a solution to what was previously a complex problem—difficult acoustic conditions.



ela

For details of the complete range and further information consult PHILIPS Free Sound Advisory Service

electro-acoustic division of PHILIPS ELECTRICAL INDUSTRIES PTY. LIMITED
Sydney, Brisbane, Perth, Melbourne, Adelaide, Hobart

PG69-57

T y probably will have eight atomic reac r power plants, each similar to the wat cooled units in the atom-submar e Nautilus.

T s will give them almost unlimited crui g range at high speed.

A tificial voice

A RTABLE voice-box which restores he power of speech to persons aflict with cancer of the larynx was den nstrated recently in Boston.

I vorks on a principle the reverse of that n a hearing aid.

I tead of magnifying sound to feed it e ear, it condenses sound and de e it to the mouth.

T e box is about the size of a cigarette t and operates from a tube attach a denture.

B teries and transistors convert sounds t lectrical impulses and then transmit e along the tube to the mouth.

N ise is bounced around in the mouth he patient can form words out of it ing his tongue, lips, teeth and other ies as he would normally.

iet jet engine

American company has claimed at a new jet engine would operate it ut causing noise nuisance.

J s have been largely unsuitable for mmercial operations because many air r have barred them as too noisy.

Quehanna, Pennsylvania, the Curss Vright Corporation demonstrated the jet engine.

e engine — known as the TJ-38 — as 12,500lb thrust.

listol Aeroplane Co., Ltd., of Fulton, n and, helped develop it.

e TJ-38 turbo-jet runs more quietly a any known commercial jet engine the company claims its noise factor uieter than some propeller-driven la es.

operates at temperatures 360 degrees r than other jet engines in its thrust la.

e new engine is expected to be availb by mid-1958.

ubber aircraft

Kansas recently, Richard Ulm un lded a rubber aircraft from a bundle bigger than a T.V. set, inflated it, a wooden propeller and took off t a thunderstorm.

lm is a pilot for the Goodyear Co., n his demonstration of the aircraft — a d "Inflatoplane" — was staged at a al air station.

he aircraft is made of rubberised ic.

has a 23ft wingspread when inflated an weighs about 200lb.

s 44-horsepower engine can pull it h ugh the air at better than 60 m.p.h., uses so little fuel it can stay aloft for t hours.

arp under control

VHAT will happen if a Harp rocket should get out of control when es are carried out at Woomera late h year? An armed Meteor jet fighter w shoot it down.

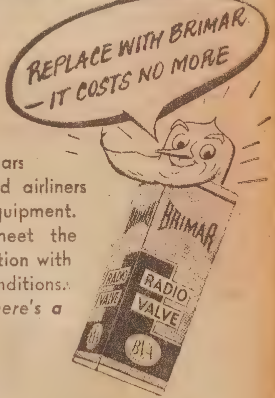
he Harp experiments will be part of A tralia's contribution to the International Geophysical Year program.

he word harp stands for high-altitude re arch project.

he authorities will take elaborate sa ty precautions in case a rocket should h d the wrong way.

adar will track the rocket in flight.

Brimar *"NEW LIFE"* valves stay young when they're old!



Brimar "New Life" valves are still packed with life long after other valves have lost their full capacity for work. Brimar Valves give you more trouble-free working hours, outstanding performance and reliability. Manufactured by S.T.C., Brimar Valves are engineered to live years longer. That's why the world's leading ships and airliners choose Brimar for their radio and navigational equipment. In fact, Brimar Valves were developed to meet the stringent demands of defence forces, and to function with complete reliability under the most strenuous conditions. *Brimar Valves will meet your valve needs — there's a type for every valve requirement.*

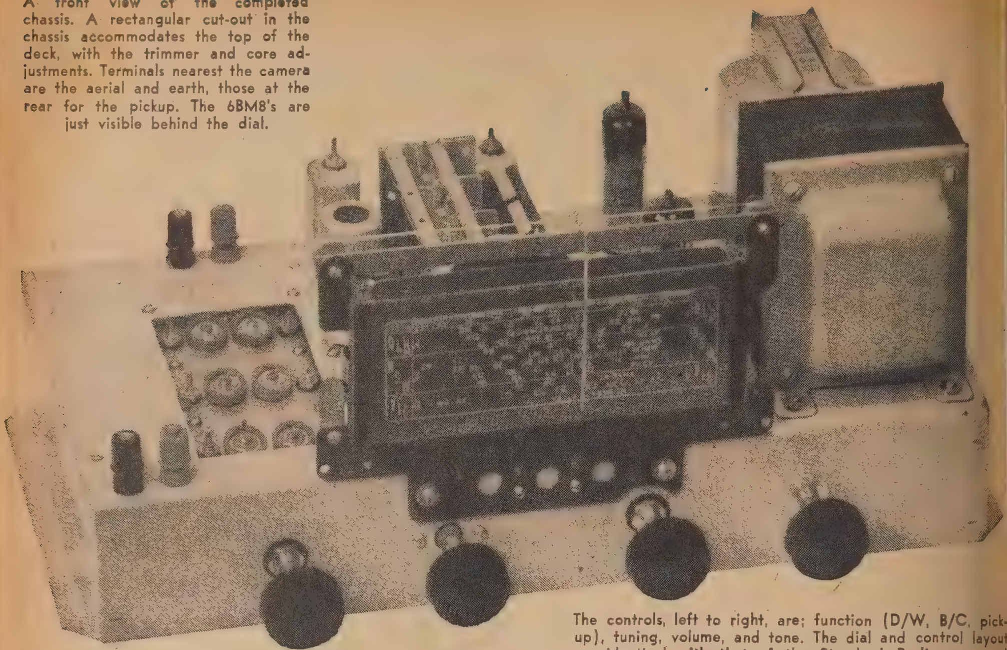
STC BRIMAR
RADIO VALVES

Standard Telephones and Cables Pty. Ltd.
Sydney and Melbourne

AN IT&T ASSOCIATE

Q214

A front view of the completed chassis. A rectangular cut-out in the chassis accommodates the top of the deck, with the trimmer and core adjustments. Terminals nearest the camera are the aerial and earth, those at the rear for the pickup. The 6BM8's are just visible behind the dial.



The controls, left to right, are; function (D/W, B/C, pick-up), tuning, volume, and tone. The dial and control layout are identical with that of the Standard Radiogram, and fit the same cabinet.

The D/W Standard Radiogram

A logical development of our Standard Radiogram described in the May issue is this expanded, dual wave version which, in addition to the excellent performance with standard pickups, has extra gain and a short wave band particularly useful in country districts. It is designed to fit into the radiogram cabinet described in last month's issue.

by Philip Watson

ONCE upon a time, when radio was comparatively simple (remember?), one of our chief occupations was to describe various types of equipment designed for similar service in different ways.

When we were very young and inexperienced, we fondly imagined that there must be one best way of making a mantel set, an amplifier, or a radiogram which would render any other approach rather profitless and waste of time.

THEY ASKED FOR MORE

But it wasn't long before we learned that no matter how satisfactorily we imagined all the problems in a given design had been worked out, there would be plenty of people who wouldn't or couldn't agree with us, and who asked for more!

And so, in those uncomplicated days referred to in our first paragraph, we made the most of our opportunities to produce infinite variations on standard themes, much to the gratification of our insatiable readers.

But time has marched onward, and our scope has widened enormously in the last few years. If we are to cover adequately all the subjects there are to be covered, we must share out our space and energies equally amongst them.

So it was that, when we received a couple of letters recently from readers who were very sorrowful about our neglect of the "big" radiogram field, we could only agree that their sorrow was justified.

It is time we included a circuit with a full size front end, complete with RF stage, and a short wave band.

The RF stage is of doubtful value to people who live near broadcast stations, particularly city dwellers, for with the higher power used these days, signal strength is often an embarrassment rather than an advantage. Very rarely is such a stage needed to improved results at close quarters.

But in country areas it is a different story, as one of our correspondents pointed out. In many such cases the extra amplification is very much worth while, and may make all the difference between useable reception and perhaps none at all.

USE OF SHORT WAVES

The short wave band is tied up with much the same story. We don't know how many people ever use their short wave bands in the city, but there is no doubt that country people often depend on these bands to get programs.

This fact is recognised by the A.B.C. who beam special short wave programs to various parts of the country specifically for their use.

Having realised the case for such a receiver, and the desire to do something about it, the radiogram circuit and bine described during the last two onth seemed to be a good starting int.

If v could work out a chassis which ould ombine the good points of that cuit with the more elaborate tuning d. d which could be fitted to the ne abinet if required, we felt we uld have done a very useful job.

The chassis part of it wasn't hard.. A r asurements revealed that it was e asy to produce a suitable layout np enough for our purpose, and suable for almost any cabinet the de had in mind.

RONT END

u next problem was how best to n the tuning end to get good re- ost economically.

u first impulse was to work out a ssentially for the broadcast band, g . wave-change switch and extra vave coils to be wired in if and r equired.

ave a horrible feeling that some- ll write to us and ask why we do just that thing!

u reason, briefly, was that we didn't h v much could be saved in pounds, is and pence by those most in- st in the idea, and who would un- h dly want the short wave band.

idding up the cost of the broad- oils, the switch, and the short e coils, plus the extra difficulty of ir ng for the necessary trimmers, i all, we found that there would be e aved as against buying a complete sembly, in which all these things p ovided for.

eover it would sit conveniently at le of the tuning gang, and, by g a simple rectangular cut-out, all justments to the coils would be in a sight.

W did not consider using any of the bate, multi-band coil assemblies c have been produced in the past, art from their size, they are more te to luxury designs which we are t ncerned with at the moment, and ry costly to buy.

OT POPULAR METHOD

E uiries around the radio stores o t out the fact that our proposed r was, in fact, the most favoured th d of making a dual waver of this e mong those who were building such e ers.

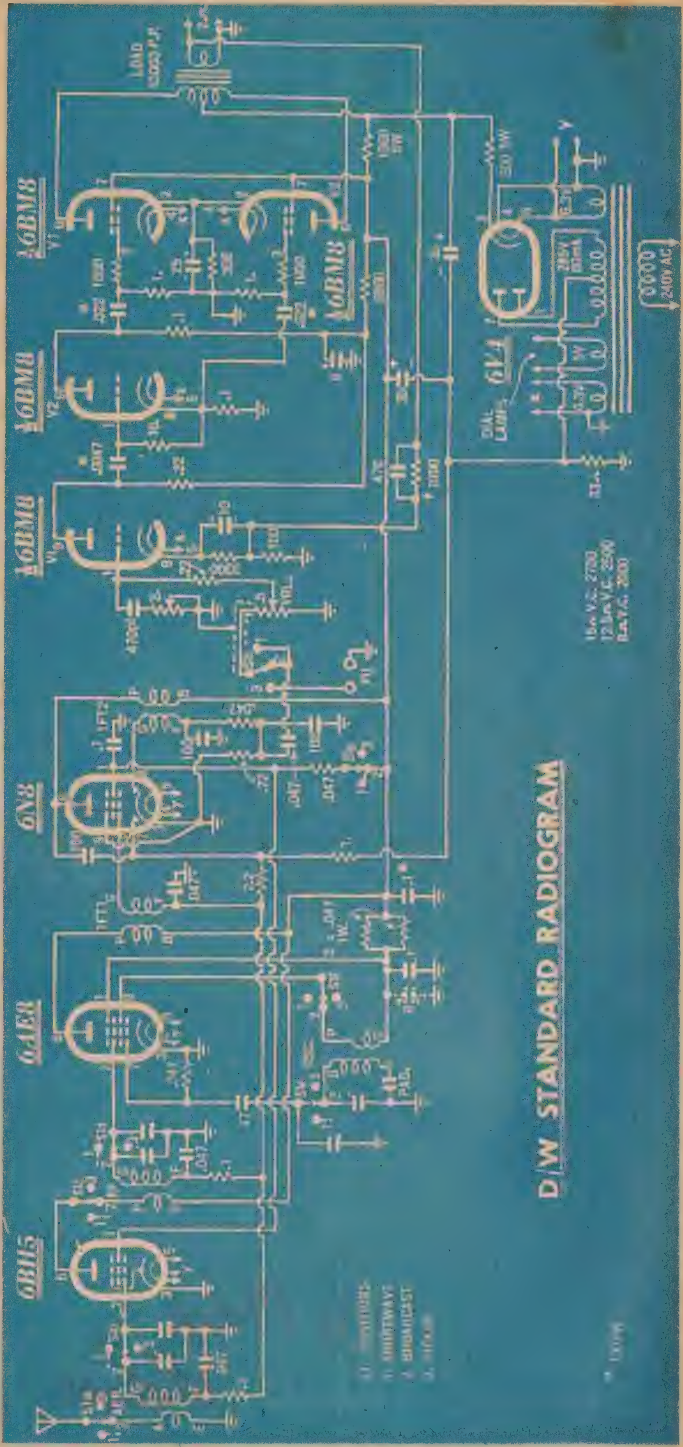
It seems that, when short wave re- ot n is required, the RF stage coil ct is far more popular than the type that such a stage, despite the extra st

ybe the idea is that, having de- le to spend a little more on a set, n uctors feel that the extra expense t larger bracket is well worth while.

S nming up, therefore, what have we a been able to produce?

V have a radiogram circuit, with tl broadcast and short waves, plus tage, obtained as cheaply in labour

CIRCUIT OF NEW D/W RADIOGRAM

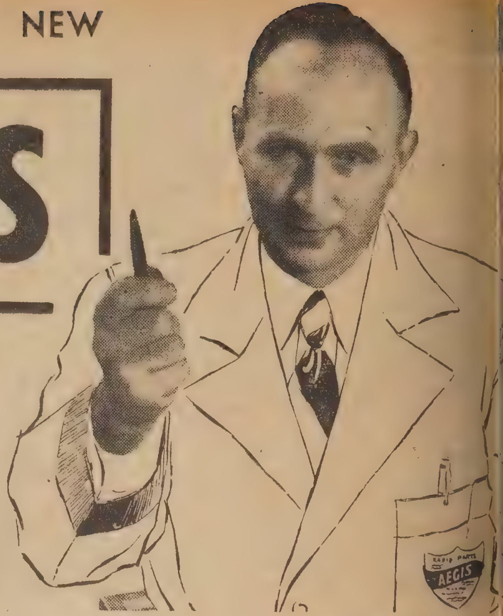


audio section is identical with t of the Standard Radiogram, le the power supply is modified provide back bias for the early ges. Much of the wiring shown contained in the pre-fabricated k, making construction relatively simple.

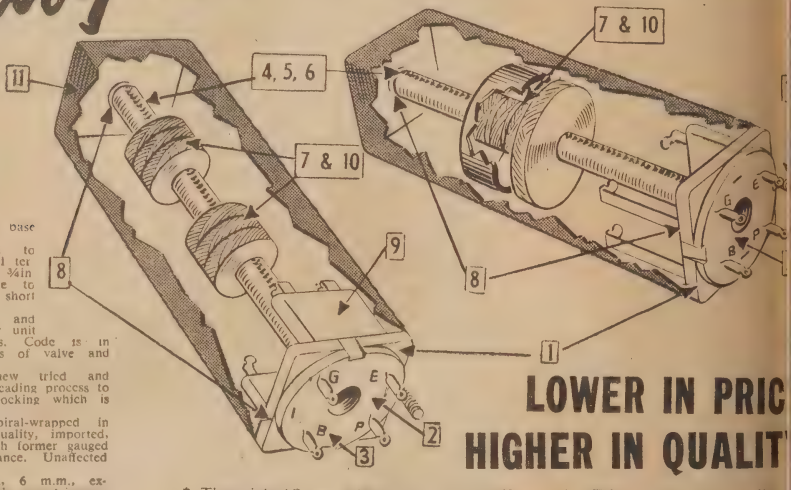
THE HIGH IQ* OF THE NEW

AEGIS

Mighty Midgets



Above: Charles van Scoy, Chief Aegis Design Engineer



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1. New low-loss bakelite base (will not melt).
2. Base specially shaped to symmetrically position all terminals within standard ¾in 9-pin valve socket hole to eliminate accidental short circuit to chassis.
3. Connection code clearly and permanently visible after unit is mounted on chassis. Code is in alphabetical abbreviations of valve and circuit elements.
4. Former incorporates new tried and proven American-type threading process to ensure automatic core locking which is vibration-proof.
5. Former is specially spiral-wrapped in manufacture from best-quality, imported, resin bonded papers. Each former gauged and held to definite tolerance. Unaffected by extreme heat.
6. Highest quality carbonyl, 6 m.m., externally threaded adjustable cores' incorp. hexagonal hollow centres — the world's greatest contribution to alignment technique. Core chipping and jamming is eliminated by use of solid nylon hexagonal alignment tool. Complete alignment possible from one end of any unit.
7. Litz. Multi-strand wire windings on all tuned circuit coils for greater Q-factors.
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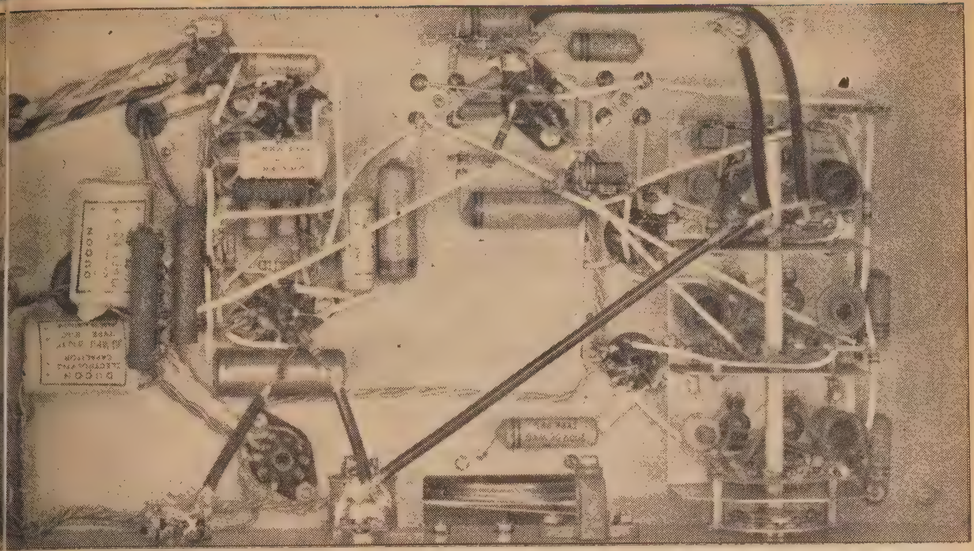

the major components are clearly visible in this picture. The dual wave deck is on the right with the 6BH5 (lower) and /8 (upper) sockets immediately alongside it. The 6N8 is approx. top centre, the 6BM8's to the left, and the 6V4 beneath them. Note the 200 ohm dropping resistor at extreme bottom left.

n money as seems possible at the sıt time.

V have an audio end, similar to t used in the original circuit, which particularly economical, neat, and eive method of obtaining good ay sound and adequate output. It cigned for use with standard, turn- e crystal pick-ups of the type gen- l employed in the average man's gram.

I it is housed in our cabinet, with pecial loud speaker damping unit ibed last month, it will sound much impressive than commercial sets ıg much more money to buy.

d finally it has great sensitivity on roadcast band, adequate to tune in nt stations on a few feet of wire good short wave reception.

Y TO BUILD

is all adds up to just the kind of our correspondents have been asking or, plus a simplicity of construction h makes it little harder to build a standard broadcast receiver.

is is largely due to the pre- licated dual-wave deck which takes of the entire coil assembly, along the associated switching. As far the "front end" is concerned it is merely a matter of connecting a tively few leads to H.T., A.V.C. ng capacitor, etc.

addition, we have modified the uit to use back bias for the early es. With three valves to be biased, effects a worthwhile saving, three stors and three capacitors being re- ed by one resistor. Not only do we the cost of these components, but ave the work of fitting them.

inally, since we are no longer in- sted in wide range, the IF channel reverts to a standard arrangement, without any switching and additional circuitry.

Reference to the circuit will show that the audio section is identical with that of the Standard Radiogram, there being little point in altering this. However we did make some changes in the power supply, and these are worth noting.

As already mentioned, we fitted a back bias network for the RF and IF stages. This is simply a 33 ohm 1 Watt resistor between the power transformer centre tap and chassis. Note that BOTH the first and second electrolytic should be returned to the centre tap rather than chassis. The need to treat the second filter unit in this way appears to be a function of the simple resistance filter used in place of a choke.

The extra valve made it necessary to reconsider both the overall transformer

PARTS LIST

1 Chassis, 14 x 7 x 2¼ in.
1 USL/37 dial (D/W. MSP gang.)
1 MSP miniature 3 gang.
1 285V 80mA power transformer.
1 Output transformer. Prim. 10,000 ohms. Sec. Suit speaker.
1 D/W coil deck with RF stage DWR/5 or similar.
2 455 Kc miniature IF transformers.
2 Noval sockets with shield.
3 Noval sockets, plain.

RESISTORS

1 10 Meg. ½W
1 2.2 Meg. ½W
1 2 Meg. Pot.
3 1 Meg. ½W
1 .5 Meg. switch pot.
3 .22 Meg ½W
4 .1 Meg. ½W
3 .047 Meg. 1W
2 .047 ½W
1 .022 Meg. 1W
1 6800 ohm ½W
1 3300 ohm 1W
1 1000 ohm 5W
3 1000 ohm ½W
1 300 ohm 3W
1 200 ohm 5W
1 100 ohm ½W
1 33 ohm 1W

CAPACITORS

2 30 mfd 350V electrolytics
1 25 mfd 40V electrolytic
1 10 mfd 40V electrolytic
1 8 mfd 350V electrolytic
1 8 mfd 350V electrolytic (Optional. See text).
1 .1 mfd 400V paper
2 .1 mfd 400V paper
5 .047 mfd 200V paper
2 .022 mfd 400V paper
1 .0047 mfd 400V paper
1 470 pf mica or ceramic
3 100 pf mica or ceramic
1 47 pf mica or ceramic
1 33pf mica or ceramic

VALVES

1 6BH5, 1 6AE8, 1 6N8, 2 6BM8's, 1 6V4

SUNDRIES

4 knobs, 4 terminals (2 red, 2 black), 3 7 lug strips, 3 5 lug strips, 1 4 lug strip, 2 3 lug strips, nuts and bolts, solder lugs, shielded hook-up wire, plain hook-up wire, 2 dial lamps, 3 core flex, 2 core flex, 3 pin power plug.

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Acos GP10	£3/12/6

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EFCO USL/46	56/6
EFCO USL/44	42/3
EFCO USL/52	74/2

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Flexible couplings 4in	7/

and the distribution of load on ament windings. Adding up the IT drain showed that it was likebe in vicinity of 90 mA under ons of no signal or weak signals, suggesting that the original 80 ransformer could be overrated e circumstances.

the other hand, a 100 mA transis not only more costly but also bulky, making it difficult to acodate on the size chassis to which re limited.

overcame the problem by assessing tal wattage consumed by the reand comparing it with the maxiwattage rating of the transformer, icated by the rating of all wind- This showed that the transformer, hole, would be operating considerbelow its maximum rating, even one winding was running some cent. high.

NSFORMER RATINGS

reasoned that the individual windas not likely to be harmed by provided the transformer was still g below its maximum temperature but we took the matter up with of the transformer manufacturers be on the safe side. When they the scheme their blessing, we ned that it was good enough.

filament distribution was not so ilt. By supplying the two 6BM8's one winding, and all other valves the other winding, we loaded each out 1.5 amps. The dial lamps may ken from either winding, shared th, or run from the five volt wind-We recommend the latter arrangesince the lamps will have much r life on this reduced voltage.

choose the 6BH5 for the RF this being a miniature type havmoderate amplification factor (by rn standards). It is therefore less to cause embarrassment to the builder, as might a higher gain with its tendency to oscillate if ayout is not exactly right. At the time there is plenty of sensitivity, on the broadcast and short-wave s. In fact, it is difficult to imagine more sensitivity could be used, anynot audible on a set of this type well down in the noise level any-

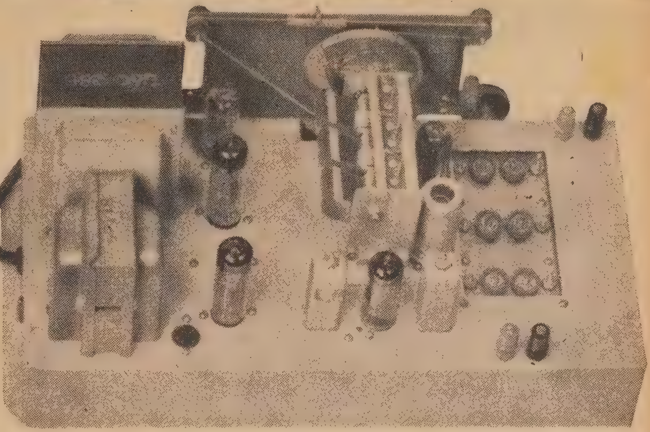
will be noticed that an extra 8 mfd rolytic is shown (dotted) in parallel the .1 mfd paper version used to ass the supply to the oscillator plate mixer screen. Its purpose is to stabilhis voltage against the possibility of r-boating on the short wave band. as not necessary in the original — h was remarkably stable in all re- s — but is included in case indivisets give trouble.

ASSIS SIZE

ne chassis is both longer and wider ne inch than its predecessor, but can be accommodated in the Standard iogram cabinet. The only precauis to see that no terminals or outsockets are mounted on the rear ide of the chassis. However, the er cable enters one end of the chassis out difficulty.

ne depth of the chassis remains as re, as does the position of the conand dial mounting holes, thus eng that they will match the layout cribed for the cabinet. However, ould be wise to leave the cutting e cabinet holes etc., until the chassis is complete.

REAR VIEW OF NEW RADIOGRAM



Here the trimmer and core adjustments of the D/W deck are seen on the right. The 6N8 is behind the gang with the IF's and the 6BM8's to the left. The 6V4 is near the front of the chassis.

The deck we chose was the DWR/5 and our chassis layout and design is based on this unit. This does not mean that other types, having the same general characteristics, cannot be used, but it would be necessary to check the physical characteristics carefully first.

Also, whatever deck you choose, we suggest that it cover the six to 18 Mc (16 to 50 metres) rather than the older seven to 23 Mc (13 to 42 metres) band. This latter misses out on several of the local short-wave bands which form a part of the complete short-wave system. If they are not available, half the usefulness of the short-wave section is lost.

DECK MOUNTING

The deck is mounted beneath a rectangular cut-out in the chassis, this giving access to the trimmers and coil slugs which are mounted on top of the deck. It is supported at the front by the switch mounting and at the rear by two bolts through the chassis. In our case it was necessary to provide a spacer, in the form of an extra nut, to balance the position of the front mounting hole.

The coil switch is a three-position one, two positions being used for broadcast and short-wave, and the third being spare. There is also a spare set of contacts on each switch section, and these facilities are used to accommodate the pickup circuit.

The spare contacts on the oscillator section are used to switch the volume control to either the detector or pickup terminals as required, the pickup terminals being mounted at the rear (top) of the chassis behind the deck.

The spare contacts on the RF (centre) section are used to open the screen supply to both the RF and IF valves when the pickup is switched into circuit. This is essential to prevent "play through" of the radio program, due to stray capacitance pickup, etc.

A good idea of the layout can be obtained from the photographs and we suggest you study these while reading the text. The RF and converter valves are located immediately alongside the dual wave deck, opposite the first and second shield partitions respectively.

The RF valve is so orientated that pin 9 is closest to the shield, while the 6AE8 socket is rotated slightly, bringing pin 8 into this position. The 6N8 socket has the pin gap closest to the rear of the chassis, and the two 6BM8 sockets face in the general direction of the coil deck. The 6V4 faces the front of the chassis.

The gang leads are brought through the chassis close to their respective terminal points, thus keeping them short beneath the chassis where their position is most critical. It is a good idea to solder a short length of hook-up wire to each lug on the underside of the gang before it is mounted, since this is not so easy to do afterwards.

A five-tag terminal strip near the 6AE8 socket supports one end of the 47 pf oscillator grid coupling capacitor, the two .047 meg. oscillator plate dropping resistors, a HT anchor point, and an anchor point for the RF and IF screen dropping resistor. This latter is connected to the common contact on the RF wave change switch, the two appropriate fixed contacts (B/C and SW) being bridged and wired to the HT lug on the far side of the deck.

Another five-tag terminal strip is mounted near the 6N8 socket. This supports the .22 meg. diode load resistor, the .047 mfd coupling capacitor, one end of the .047 meg. decoupling resistor, and one end of the 100 pf mica by-pass.

AVC COMPONENTS

On the opposite side of the second IF transformer a two-tag strip serves as an anchor point for the 1 meg. AVC load resistor and to which is run a lead from the back bias resistor.

The AVC components associated with the RF and converter stages are mounted on or between terminal lugs already provided on the far side of the dual

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ave deck. One extra terminal strip m inted at the rear corner of the ck o serve as an anchor point for ie the .1 meg. resistors.

A described in the May issue, the di section is constructed around a e id a seven-terminal tag strip run ng tween the two 6BM8 sockets, the rg one being closer to that end of e assis. Another seven-terminal strip ar supports the 1000-ohm filter re- to the back bias resistor. and some t electrolytic leads.

T power transformer primary leads e rminated on a four-terminal strip tra terminal being required to ac m odate the lead to the potentio- te switch The 200 ohm dropping si r is mounted on a doctored seven n al strip in the front corner of the as (It is important to keep this si r away from the volume control d udio leads.) It is mounted by ea of one of the power-transformer o ting bolts.

S elded cable (PT9M in our case) is e for the audio connections, a lead r the detector running along the c of the chassis to the switch section t dual-wave bracket, while another c from the common contact runs g nally across the chassis to the l ne control.

IING PRECAUTIONS

A und the volume control itself it cessary to take a few simple pre- u ons to avoid hum pick-up The 0 A.C. lead running to the volume nol switch contacts must be twisted d tucked well away from the audio a up against the front fold of the a is

T e same applies to the lead from athode of the rectifier to the 200 r limiting resistor. This lead is r ularly important, since it is carry- ie unfiltered output from the recti- r nd can set up quite a substantial The same applies to the 200 ohm ior, and is the reason for its place- in the far corner of the chassis.

le leads from both the volume and controls to the input grid terminal be shielded and should be run t. The 400 pf. and the .22 meg. ior should be mounted as close as ble to the grid pin.

nother probable source of hum— peculiar to this set-up —involves arthing of the gramo-motor frame. is normally connected to the outer of the pickup cable, thus forming of the input signal path. If, in ion, we earth the motor in the ial way through the third wire of power cable, there is a real risk of ting a hum-inducing earth loop. is especially so if the motor is ated from a separate lead to the power point.

THING CIRCUIT

we depend entirely on the earthy of the pickup circuit to earth the or frame the possibility of an earth will be eliminated, but we create otentially dangerous situation inas- h as the motor has no protective if ever the pickup is temporarily nnected from the chassis. In the t of a motor breakdown the resul- live frame would be very dangerous eason of the adjacent well-earthed sis.

ne best solution appears to be that aking the power lead to the motor from the power transformer input terminals, using a conventional three-core cable. In a set of this kind where the audio gain is only moderate, it will probably be sufficient to earth this lead to any convenient point on the receiver chassis However, if hum due to this source is still in evidence, it should be earthed directly to the pickup input earth terminal.

Provided these few simple precautions are taken the output should have an extremely low hum content, in spite of the simple filter network.

The actual construction should not present any difficulty, particularly if a correctly punched chassis is used. This is really half the battle and we suggest that one of the ready-made variety be obtained along with all the other parts. Alternatively, you can make your own if you have the facilities, and blueprints will be available through the query service in the normal way.

Either way, the fact that all the holes are punched in the right place removes most of the guesswork, and it is then mainly a matter of commonsense to ensure that the various grid and plate leads are kept short and well clear of each other.

One small point which can be easily overlooked concerns the two A.V.C. resistors which connect to the 6N8 diode. These should be mounted as close to this pin as possible: this end of each being "hot," while the other end is "cold" and not particularly critical

MORE ABOUT OUR T.V. RECEIVER

ELSEWHERE in this issue, we give you the third and final article describing the basic 17-inch Television Receiver. Already, however, we are receiving enthusiastic reports from readers who have completed the set and are getting excellent results from it.

Next month we will tell you how to add Gated AGC, enlarge the sound channel and, if time permits, add a cascode RF amplifier to your home-built tuner. We may be able also to give additional helpful information about aerial systems, installation and alignment.

When everything is completed it will probably be found that the set works immediately, since both the I.F. transformers and the coil deck should be roughly aligned as you receive them. However, it will be essential to align the set correctly if the full benefit of the design is to be realised, and a few points on this subject may be helpful.

Although it is possible for experienced workers to produce moderately accurate alignment using only the signals from broadcast stations, this arrangement, at best, can be considered only as an emergency measure. If the set is to give really top performance we must assume that a signal generator is available.

Almost equally important is an output meter. This facility is normally found on most multimeters, and the signal is usually measured across the primary of the output transformer, or between one output valve plate and chassis. Set it initially to the highest voltage range, reducing it only when the operating level has been established and is not likely to change suddenly. Failure to observe this may result is an overloaded meter.

The first section to be adjusted is the I.F. channel. Set the generator to 455 Kc, with modulation on and adjusted to about 30 pc. Output from the generator is fed to the signal grid of the 6AE8 converter (pin 2) and it may be necessary to refer to the generator manufacturer's instructions to determine whether the outlet terminals may be connected directly, or whether any additional coupling device is necessary

V/C SETTING

Ideally the receiver volume control should be advanced to maximum, and the input from the generator kept at a minimum throughout the entire alignment procedure. The reason behind this is to keep the input signal below the level where it would normally bring the A.V.C. circuit into action. The A.V.C., by attempting to compensate for changes in signal strength, tends to mask the improvements in sensitivity due to adjustment

In practice it may be difficult to operate the set—particularly one with an R.F. stage—"flat out" without running into interference from strong local stations During the I.F. alignment short the aerial and earth terminals and set the tuning gang to the wide open position.

Starting with the second I.F., adjust each core for maximum signal, reducing the output from the generator as the output from the set rises. Some cores will show a peak in two position; well in and well out. The outermost peak should be selected. Go over the entire channel several times until you are satisfied that all adjustments are optimum. Then seal each one securely.

Transfer the generator leads to the aerial and earth terminals (removing the short) and set the generator to 600 Kc. Set the receiver dial to 600 Kc and adjust the B/C oscillator slug until the signal is received at maximum strength. Follow up with the R.F and aerial slugs.

(Once again, trouble may be experienced in operating the set at full gain without interference. In the absence of a screened room the amateur can only compromise on the control setting, keeping it as high as possible at all times.)

HF END

Now set the generator and receiver to 1400 Kc and adjust the oscillator, R.F., and aerial trimmers in that order, not forgetting to reduce the output from the generator as the gain comes up. It may be necessary to repeat both the foregoing operations for best results Then seal all adjustments securely.

Finally, comes the short wave band. The procedure here is similar to the broadcast band, the slugs being adjusted at the low frequency end at about 7 Mc (43M) and the trimmers at the high frequency end around 16 Mc (19 M). However, adjustment will be more critical and it is sometimes helpful to rock the dial gently across the signal as adjustments are made.

A further precaution is to avoid being mislead by the double spot. If the signal is strong enough it will be found at two spots on the dial. The signal having the higher of the two frequencies is the correct one

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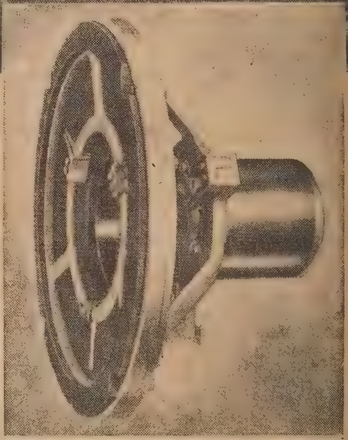

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cons of the mother quartz used in crystals cemented on glass plates for final cut-
gnto slabs from which the final accurately ground wafers will be produced. These
are used for controlling the frequency of transmitters.

adio Transmission-
ow It Works

aving taken in a good deal about the fundamentals of radio components and circuitry, now remains to bring these together to form a mental picture of how speech and music can be carried by radio waves to distant points. Hence the title of this article.

☆ ☆ ☆

Oscillator stage and the tuned circuit. Frequency and quartz crystals. RF power amplifiers. The transmitting aerial. Morse code. The nature of sound. Modulation amplitude and frequency. A complete transmitting station.

☆ ☆ ☆

IO transmission is an extremely volved subject and one on which specialised textbooks have been . Quite deliberately, we're go- bypass a lot of the difficulties etail in an effort to give you a picture of the processes by radio transmission and reception hieved.

this general background, one better position to learn the prac- essons which are to be had from g the first small radio set—no how modest it may be.

ugh there may still be an element stery about it all, this prelimin- udy of principles will prevent dio set from being a completely gless jumble of wires. Let us omething, then, of the transmitter. heart of every modern transmitter is the so-called OSCILLATOR stage, which generates the initial radio frequency signal.

In our chapter on electrical circuits, we learned of the oscillatory tendencies of a tuned circuit comprising an inductance and capacitance in parallel; how that an initial impulse causes a train of damped waves to be generated, of substantially constant frequency but diminishing amplitude.

A tuned circuit thus exhibits a "flywheel" effect in an electrical sense, transforming an initial single impulse into a more sustained electrical phenomenon.

In this respect, there is a simple mechanical analogy to a flywheel, and the analogy can be taken a step further. The energy evident in a revolving flywheel is of a limited and temporary nature, so that the flywheel is of little use as a source of power. It comes to rest as the energy is absorbed by frictional losses and any superimposed mechanical leading.

But a flywheel becomes invaluable if it is coupled to a driving piston. The periodic thrust supplied by the piston is changed to a smooth rotary motion by the action of a crank and flywheel.

So it is with a tuned circuit. A single damped oscillation, or even a series of such oscillations, are of limited use for radio work. But inventors have found means of coupling a radio valve to a tuned circuit to maintain the latter in a constant state of oscillation.

LIKE FLYWHEEL

Just as the piston delivers a mechanical impulse to a flywheel under the guidance of a mechanical valve system, so does an electron tube—or valve in the electrical sense—deliver electrical impulses to a tuned circuit.

The amplitude of the wave train, instead of diminishing, is kept constant and continues for just as long as the circuit is left in operation. The effect is illustrated in figure 1.

The complete combination of tuned circuit, valve and associated components is referred to as an oscillator stage. In actual fact, there are numerous circuit arrangements, all of which achieve the desired result, but some more conveniently than others.

An elementary type of oscillator, which will serve to illustrate the basic principle, is illustrated in figure 2. Here, a tuned circuit comprisng L1 and C1 are coupled to the grid of a valve through capacitor C2. Another coil, L2, is connected in series with the plate supply and coupled inductively to L1.

When the circuit is switched on, there is an initial and increasing movement of electrons from cathode to plate, through the coil L2, to the high tension supply source. The flow of current through L2 creates an electromagnetic field, which naturally influences and induces a voltage in L1.

The relationship is such that the grid receives a slight positive impulse as a result, and this tends to accelerate the rise in plate current. This, in turn, accentuates the initial effect in L2.

The grid is driven positive to an extent where it attracts a big proportion of the electron current, so that the plate current can no longer maintain its rising tendency.

The magnetic field around L2, there-

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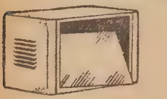

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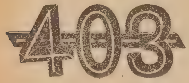

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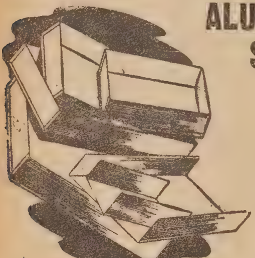

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trical Musical Industries are a few doors up, and Ball
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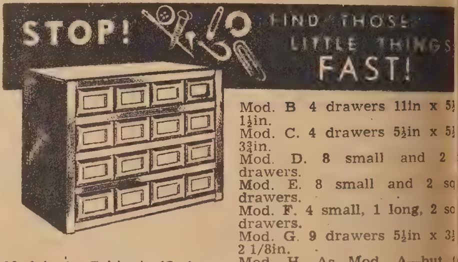
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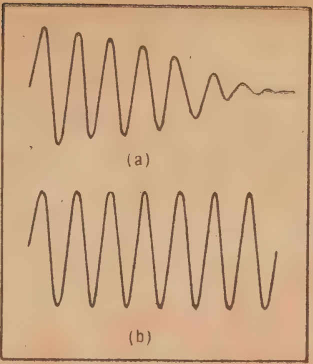

Figure 1: Illustrating a damped train (a) and a sustained wave train (b), as produced by a valve oscillator.

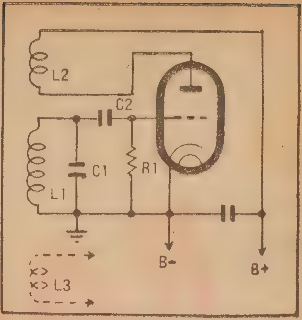

Figure 2: A simple oscillator circuit. Energy is fed back from the plate coil L2 to the grid coil L1. Output can be taken to external circuit through the coupling coil L3.

ore begins to collapse, inducing a re-
ers change in the field around L1, so
at he grid now begins to become in-
sa ngly negative. The process ac-
le es until it is negative enough to
t f the plate current.

O e the decreasing effect in plate
rr t ceases, the magnetic fields around
d L2 begin to collapse and re-
rs and the whole process is repeated
ai and again. The tuned circuit L1,
maintained in a constant state of
ci tion until such times that the
pp to the valve is interrupted. The
m nents C2 and R1 have an import-
t earing on the smooth functioning
circuit.

A oscillator circuits operate in much
ame way, but the circuit details
in the method of feeding the
y from the plate back to grid.

T frequency of the alternating volt-
enerated is determined mainly by
onstants in the tuned circuits —
by L1, C1. In practice, it is likely
affected slightly by humidity and
rature, by physical variations in
mponents, and by variations in the

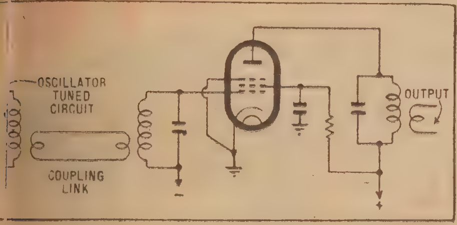

Figure 3: The basic circuit arrangement for an RF power amplifier using, in this case, a pentode valve.

☆

☆

ly voltages to the oscillator valve.
ppreciable frequency variation is
undesirable — and often illegal —
ven modest transmitting equipment,
at every effort is made to avoid it.
ly voltages to the oscillator valve
regulated electronically and, in
y cases, the whole oscillator stage
contained in a temperature-con-
ed oven, to minimise the effects of
spheric changes.

e problem of maintaining frequency
ility has been simplified by a re-
kable device and phenomena —
ely the PIEZO-ELECTRIC effect
bited by certain crystals.

YSTAL OSCILLATES

has been found that, when slabs of
ain crystals are subjected to
hanical stress, a small voltage ap-
s between opposite faces, and, in-
ely, when a voltage is applied to
e faces, the slab of crystal becomes
slightly distorted physically.

ut, what is more important, a crystal
show surprising activity — a mark-
scillatory effect — if it is excited
rically at a particular frequency
rmined by the mechanical properties
dimensions of the crystal.

actual fact, it behaves electrically
similar manner to a very efficient
d circuit. Thus, when a crystal
nnected in appropriate fashion into
scillator circuit, the valve will gener-
oscillations exactly as if there were
ally an efficient tuned circuit coupled
s grid.

ecialists simply grind the faces of
crystal until the natural frequency
scillation is exactly as desired, and
the crystal will oscillate electrically on this frequency with less tendency to wander than an ordinary tuned circuit. If it is installed in a temperature controlled oven, so much the better.

Hence the term CRYSTAL CONTROLLED transmitter.

Our normal broadcast band extends from 550 to 1600 kilocycles per second, so that crystal oscillators at the various broadcast stations are adjusted to generate the exact signal frequency on which the station is allowed and required to operate.

Various other services—shipping, news, telegraph, etc.—utilise stations at frequencies higher than 1600 Kc/s. and there are also SHORT-WAVE broadcast stations operating on frequencies up to about 30 megacycles per second. Beyond that again are frequencies utilised for FREQUENCY MODULATED transmissions, TELEVISION and RADAR.

Every one of these transmitters has its own oscillator stage—generally crystal controlled.

The power supplied to the tuned circuit (figure 2) by the oscillator valve is more than enough to maintain the oscillation. In fact, power can be led off from the tuned circuit to an external circuit.

The usual method of coupling the oscillator to an external circuit is to mount a small coupling coil (shown as L3 in figure 2), so that it is inductively coupled to the main tuned circuit. The signal voltage induced in L3 can be applied, if necessary, direct to an aerial/earth system for purposes of transmission.

POWER AMPLIFIER

But except in the most elementary transmitting equipment, the aerial is never coupled direct to the oscillator stage. For one thing, it is difficult to obtain the necessary power output from the oscillator, without compromising the requirements for frequency stability.

The inductive and capacitive properties of the aerial system, when intimately coupled to the oscillator tuned circuits, affect their natural resonant frequency and therefore the frequency of the signal generated.

Other undesirable effects accrue from the necessary requirement of imparting intelligence to the RF signal—something which yet has to be discussed.

Principally because of these considerations, it is usual practice to add one or more radio frequency power amplifier stages after the oscillator. These build up the power of the signal to the necessary figure, and isolate the oscillator from the effects previously mentioned.

The oscillator itself is designed to generate only a comparatively small initial signal voltage and power, but very accurate and constant with respect to frequency.

A transmitter may use one or more amplifier stages after the oscillator, and they are usually coupled one to the other and to the oscillator by a series of resonant circuits (See figure 3).

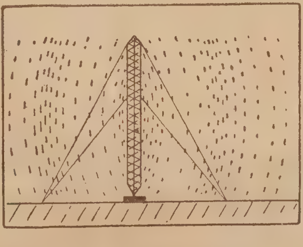

Figure 4. A transmitting aerial can be likened to an enlarged tuned circuit surrounded, in operation, by magnetic and electrostatic fields. Because these fields move out into space, radio energy is "broadcast".

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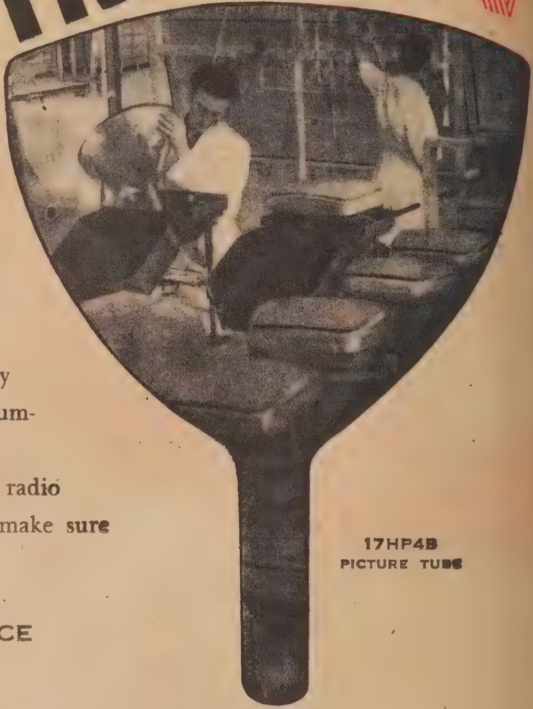

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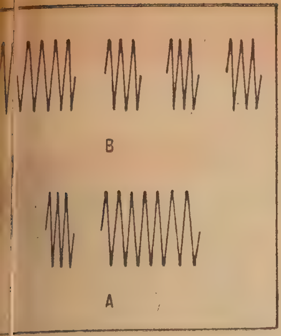

re 5. The most elementary means
of putting "intelligence" on a
o carrier is by means of the Morse
. A different pattern of short
ts (dots) and long bursts (dashes)
radiation indicate letters,
figures, &c.

t is unnecessary, at this stage, to
further on the subject of RF
amplifiers, save to mention that
ist one feeds the high frequency
developed in its plate circuit into
rial/earth system for purposes of
mission.

a general rule, the radio frequency
absorbed by a transmitting aerial
proximately one half the DC power
tts (volts x amps) fed to the plate
t of the final RF power amplifier.

may be the cause of some wonder
now an aerial system can absorb
adiate power into space. Actually
a very involved subject, but the
ving will give some form of mental
re of how it comes about.

is necessary to realise that trans-
ng aerial is not just a length of
suspended more or less at ran-
as generally happens with a re-
ng aerial. Nor is it just a vertical
put up to impress the passers-by.

hether it takes the form of a sus-
ed wire or a vertical steel tower, it
sses capacitive and inductive pro-
es and these are carefully consider-
t the time of erection.

GE TUNED CIRCUIT

aving such properties, it may be
ed to a gigantic tuned circuit, with
ite resonant effects. And, further
, the length of the aerial or tower
s a definite relationship to the wave-
h of the signal to be transmitted.

nowing the frequency and wave-
th on which the broadcasting station
operate, the design engineers cal-
c the length of aerial which will
approximately the required char-
istics, and stipulate the way in
h the high frequency energy must
ed into it. Any adjustments neces-
thereafter are effected with the aid
auxiliary tuning and coupling cir-
.

hen a signal voltage is fed to a
entional tuned circuit, then energy
ds up an alternating magnetic field
nd the coil and corresponding elec-
atic charges across the condenser,
gy is drawn from the source each
the alternating magnetic field is
up, but returned to the source as
the magnetic field begins to collapse an instant later.

Only a small proportion of the energy is lost, depending on the characteristics and efficiency of the tuned circuit.

But let us imagine that the inductance is enlarged in physical dimensions, so that the magnetic lines of force surrounding it spread over a greater area. As the field collapses each time, fewer of the magnetic lines will cut the coil, and therefore less energy will be returned to the source. In other words, the tuned circuit will absorb and dissipate more of the energy fed into it.

Now consider the extreme case where the inductance is amended until it becomes a single length of aerial wire or a vertical steel tower. It will have inductive and capacitive properties and, in addition, a definite relationship to the wavelength of the signal to be transmitted.

When high frequency energy is fed to it, lines of force are set up around it, extending necessarily over a large area. But on the portion of the input cycle where the magnetic field collapses, the energy does not all return to the source; instead, the lines of force move outward into space.

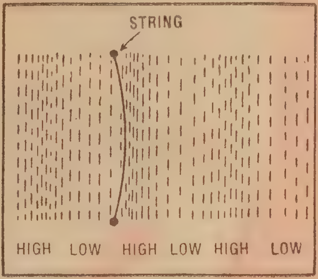

Figure 6. A string or reed, in vibrating, causes pressure waves in the surrounding air, which we interpret as sound. Vibration of the supporting framework in sympathy with the string increases intensity of the sound.

Thus, the high frequency energy developed in the plate circuit of the final amplifier is fed into the aerial system and radiated by it as an electrical wave.

Just as the ripples spread outwards from a centre of disturbance over the surface of a still pond, so do the electrical undulations emanate into space from the transmitting aerial. The distance they cover before fading into apparent nothingness depends on the original output power and the frequency of transmission.

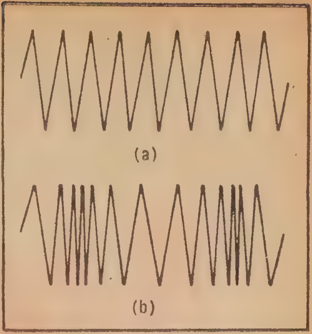

Figure 8. In frequency modulation, the effect of the audio signal is to produce a variation in the frequency of the carrier signal. the amplitude remains constant.

Our broadcast-band stations are intended mainly for coverage within a radius of a few hundred miles. But signals radiated at higher frequencies—the short waves—skip half-way around the world with ease.

Thus far, we have envisaged only the radiation of high frequency radio energy without any thought of transmitting intelligence by it. Obviously a radio wave transmitted into space without such a provision is as meaningless and futile as a blank sheet of paper mailed through the post.

MORSE CODE

The next question is that of imparting an intelligent message to the radiated energy so that it can be picked up at remote points and the message understood.

One very simple approach to this problem is offered by use of the so-called MORSE CODE. At the transmitter, an operator is provided with a morse KEY, which is so connected to the circuits of the transmitter that energy is radiated only when the key is depressed.

With the key in the normal open position, no energy is radiated.

If now the operator wishes to send the letter "A," he presses the key to send a brief DOT, followed immediately by a longer DASH. The letter "B," on the other hand, is represented by a dash and three dots, and "C" by the combination dash, dot, dash, dot.

There are standard code signals for

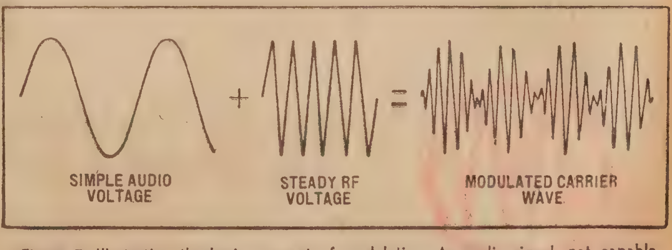

Figure 7. Illustrating the basic concept of modulation. An audio signal, not capable of being transmitted directly, is superimposed on a radio "carrier", to produce the result as shown.

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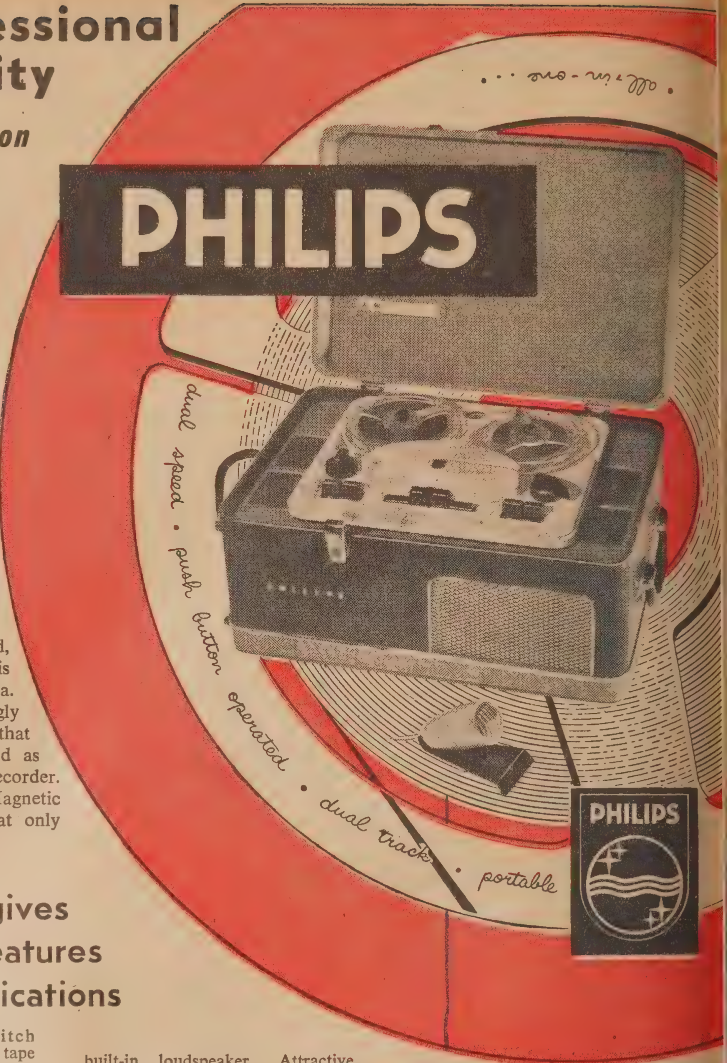
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DUAL-TRACK SYSTEM: Gives extended recording time and permits uninterrupted recording of 2 x 90 minutes (with long-play tape) or 2 x 60 minutes (normal tape).

EASILY PORTABLE: Weighs 32 lbs.

ALL-IN-ONE DESIGN: One case, complete with microphone and built-in loudspeaker. Attractive finish with washable plastic case cover and removable lid.

HIGH-FIDELITY REPRODUCTION: The properties of microphone, amplifier, loudspeaker and recording/playback head ensure excellent quality. Here is a recorder that provides good sound reproduction even at the low speed of 3¾".
This is especially so when connected to a good external speaker system similar to the Philips "full range" speaker, type 9762M.

MIXING FACILITIES: Two programmes may be mixed in the desired intensity ratio through the extension sockets and the Philips high-quality dynamic microphone, type 1115.

FAST FORWARD AND REWINDING: This can be effected within two minutes and accidental erasing is impossible.

OTHER OPTIONAL FEATURES INCLUDE: Foot switch and programme indicator.

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letters of the alphabet, for the als, punctuation marks, and also s of abbreviations for certain frey-used expressions.

rators become extremely proficisending and reading morse code es, typical operating speeds varyetween 15 and about 25 words inute.

substantially higher speeds, mesare transferred by a special ne to a tape, then transmitted eceived by tape at a speed far than possible by direct human

act, the whole job of coding and ng on tape can be done autolly on machines which are operomething like a typewriter.

ED USE

morse code, and similar code s, are widely used in communicircuits, the circuits offering a amount of secrecy and occupyminimum space in the rather ed frequency spectrum. Furthercode signals can often be folunder atmospheric conditions would rule out other forms of ission.

code transmissions are obviously attractive proposition to the aver stener, whose natural desire is to normal speech and music emanatom the receiver.

make this possible, the high frey CARRIER wave is MODULATwith signal voltages representing and music, and these become le again as such at the receiving

ore the process of modulation can derstood it is first necessary to something of the nature of sound. mple approach is to visualise a ing string, as on a violin, guitar, etc.

pending on its mass, length and n, such a string has a certain al period of vibration. Exactly ame is true of the reeds in a harm or accordeon, or the column in organ pipes, when suitably ex-

string or reed in a state of rapid tion disturbs the surrounding air ets up pressure waves, which radiutward at a uniform speed of about feet per second.

CTRICAL DISTURBANCE

t as a falling stone produces a of ever-widening ripples on the ce of a pond, so does a rapidly ting body cause waves in the surding air. When a string or reed s in one direction, it builds up a presure in front of it, and a pressure "ripple" moves away the string.

instant later the string moves in opposite direction, and creates a t rarefaction, so that a correspondow pressure ripple follows the high ure one. (See figure 6).

y device which initiates similar ure waves constitutes a source of d. But disturbances in the air only me evident as sound when they ate our ears.

side each ear is a thin membrane we know as the ear drum, and is very sensitive to external air pres- A slight increase in pressure causes drum to stretch inwards and a case causes it to move outwards.

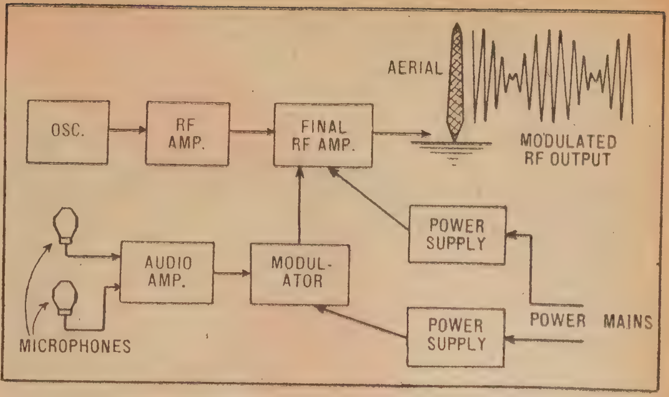


Figure 9. Here is a complete transmitting station illustrated in block schematic form.

If we happen to be nearby when our violin or piano string is vibrating, it is reasonable to expect our ear drums to be affected by the rapid variations in air pressure — that is by the pressure waves.

This is indeed exactly what happens. The ear drum vibrates in and out in sympathy with the waves emanating from the string.

The movements of the drum in each ear are communicated by a sensitive bone structure to nerve ends, which despatch corresponding impulses to the brain. Our brain interprets the impulses as sound. The intensity of the drum movement determines the impression of loudness, while the frequency of the vibration determines the musical PITCH of the sound.

BASS NOTES

Notes of a low vibration frequency, down to about 30 cycles per second, are described as BASS notes. High frequency or TREBLE notes extend to something between 10,000 to 15,000 cycles per second, beyond which our ear mechanism ceases to function.

We have assumed that a vibrating string vibrates at only one frequency at a time, but this is not necessarily true. In actual fact, its mode of vibration may be very complicated so that it generates the expected FUNDAMENTAL frequency plus a variety of so-called HARMONIC frequencies which are exact multiples of the fundamental.

The presence or absence of various harmonics determines the nature of the sound — whether it is harsh or liquid in quality, shrill or mellow.

Percussion effects, as evident in bell, piano or drum notes result from a sound impulse of complicated structure and high initial amplitude, which almost immediately resolves itself into a lower amplitude impulse of more clearly defined frequency.

The sounds we are aware of in everyday life represent a complicated series of impulses, with ever-changing characteristics of frequency, harmonic content and amplitude.

The sound pattern radiated from an orchestra is highly complex in character, containing an innumerable variety of harmonics, overtones, amplitude variations and all the rest; but, for all that, our ears and brain in combination still manage to sort it all out.

Ordinary spoken words are likewise a highly complex pattern of sound waves, originated by vocal chords and unconsciously modified in harmonic content, amplitude and general character, by the action of lips and tongue.

The essential connection between these complicated sound waves and a radio transmitter is provided by the MICROPHONE. This device has a sensitive diaphragm, which is caused to vibrate in sympathy with sound waves striking it, just as the drum in our ears.

The microphone converts the periodic variations in pressure on its diaphragm into minute electrical impulses; into alternating currents and voltages, whose amplitude, frequency and harmonic content are an exact electrical replica of the pressure variations which are the original sound waves.

In the broadcasting studio, one or perhaps several microphones are set up to intercept the sound waves generated by the announcer's voice, or by an instrumental combination, or any other sound source which may be employed.

"AUDIO" AMPLIFIERS

The microphones convert the sound faithfully into minute electrical impulses, and these are passed into a series of valve AMPLIFIER stages, where the electrical impulses are increased greatly in magnitude.

So amplified, the impulses—now known as AUDIO FREQUENCY voltages—are fed in any one of several ways into the transmitter, which we will remember is simultaneously generating and amplifying a very much higher frequency voltage for radiation into space.

In normal practice, the audio freqency voltages superimposed on the carrier tend to vary the AMPLITUDE of the latter, in the manner illustrated in figure 7. This method, employed in Australian broadcast stations, is known as AMPLITUDE MODULATION.

An alternative method of modulation (the process of superimposing a signal on a carrier wave) is to have the audio voltages vary the frequency of the car-

(Continued on Page 120)

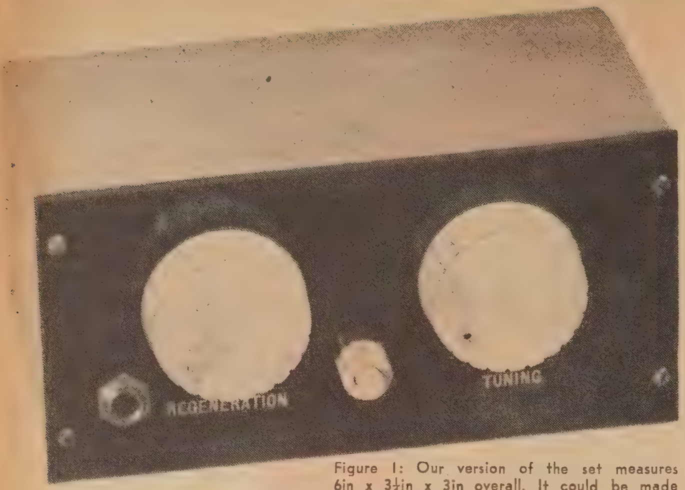


Figure 1: Our version of the set measures 6in x 3¼in x 3in overall. It could be made very much smaller if you are keen to save as much space as possible.

A Regenerative Set With Two Transistors

You've now completed last month's transistor receiver and find that you can receive most local stations at full headphone volume. But still there are some distant stations you would like to hear at better strength, or perhaps reception of the locals without a special aerial would be a worthwhile feature. The answer is a transistor amplifier stage.

by Maurice Findlay

THE actual job of adding the extra stage has so little to it that we would have difficulty in writing a full length article on the subject. At the same time there is a lot of theoretical background to the seemingly simple circuits and many of our readers starting to become familiar with transistors will appreciate some information on things like characteristic curves, bias circuits and the like.

If some of the article is a little too hard to understand fully at this stage don't worry because the set will work perfectly wired according to the circuit diagrams without any special adjustment.

EARLIER ARTICLE

You may remember last month that we talked briefly about transistors as amplifiers and set out a table giving the features, in general, of three ways of wiring them into circuit. You may remember that the common emitter arrangement appeared to be the most useful since it has medium input and output impedances combined with a high current gain.

The common base circuit has a low input impedance and high output impedance. The current gain is low (a little less than 1 with junction transistors), but the change in impedance level makes possible a high power gain when the devices coupled to the input and output of the circuit can be matched.

The common collector arrangement has a high input impedance and a low output impedance, in general, combined with a high current gain. It is useful as a matching stage, but is not used as often as the other two configurations.

The transistor in last month's receiver was wired with the emitter common to input and output circuits, but the bias was adjusted to give the best c all gain when the functions of d tion and amplification were comb in the one stage.

Audio gain was not as high a possible with a stage specially adju nor was the maximum power ou very high. With no detector action consider, we can concentrate on signing for gain and power output.

Data on maximum voltages, curr and dissipation are available from transistor manufacturers. Also we obtain characteristic curves for input and output circuits, in the c mon base and common emitter rangements at least.

DESIGN METHODS

For engineering purposes, syst have been developed to enable tra tor performance to be predicted f calculations. This is a subject a which it would be possible to w a number of articles and if you hav already had some experience with t sistors, it could easily be difficult digest.

The transistor can be considered a network of resistances, capacitors generators, and if the values of the sistances, capacitors and the characte tics of the generators are known, cuit performances can be calcul using basic electric circuit theory. T useful systems are the T-network p meters and the h-parameters data which are usually published. Equiva network capacitors can often be o ted at audio frequencies with small ror.

T-parameters are simply based on arrangement of resistors in the eq alent circuit while the "h" stands hybrid and springs from the fact some of the parameters are resistan some conductances and some pure nu bers. These parameters vary with operating conditions, while temperat also enters into the behaviour of circuit. Curves giving the change parameters with conditions are quently available.

MOST USEFUL

Our experience with transistor culations has not been extensive b so far, we have found the h-paramet the most useful for predicting the p formance of multi-stage audio am fiers. The parameters apply only small signal conditions although t often hold quite well up to the p of overload of the stage. When desi ing stages to operate at levels comp able with the maximum output of transistor, it is usually best to w directly with the curves.

Transistor calculations are, in gene more involved than valve calculati When dealing with valve amplifiers are concerned mainly with the volt at the grid (current is usually negligi while, in many cases, the coupling the output (plate) and input (grid) s is small enough to be neglected.

h the transistor amplifier we are concerned with the alternating nent of current flowing in the in- rcut but the input impedance is y high enough for the voltage ped to be appreciable. There is coupling between the input and circuits, making transistor cal- ns something like valve calcula- when the grid to plate capacitance n into account.

NDARD CIRCUITS

needn't decide at this stage to ransistors away altogether, because bly there will be some standard arrangements and values evolved will serve many cases. For ex- , readers who have seen valve cir- ome and go will be familiar with d "one, two, three" with the 6V6 valve: 250 volts plate and screen, hm cathode bias resistor, &c.

perature is a factor which must concern the designer of tran- circuits, since transistor charac- s change quite drastically, parti- at higher temperatures. A re- network is frequently used to se operating conditions while, in cases, temperature sensitive re- are included for more effective l.

us now look at some of the s we will have to consider in de- g an output stage for our small er last month.

DPHONES

dphones are extremely sensitive ms of the amount of power re- l to give an acceptable audio level. ugh it may be desirable to design ircuit to give as much output as le, this would only be done if e same time the gain could be a maximum since, for the moment, st, we are more concerned in bring- eak signals up to a level where possible to hear them comfortably.

gain, in terms of power output headphones for a given alternating onent of input current for small input, depends mainly on the load lance in the transistor collector cir- The optimum value depends to extent on the part of the charac- c to which the transistor is biased but will be of the order of 10,000 ohms for the OC71.

In other words, if the gain of your receiver is limited, you will get best volume by using a load impedance of 10,000 ohms. This is not the same thing as maximum power output and, in fact, if you have plenty of gain, the optimum load is about 1,000 ohms when, given appropriate bias and collector voltage, the possible power output will be many times that with the 10,000 ohm load.

The maximum steady voltage which may be applied to the collector is 5 volts, although a peak value of 10 volts is permitted. When an inductive load, such as a pair of headphones with low resistance, is placed in the collector circuit, the maximum supply voltage which can be used is 5 volts.

Both the steady and peak collector current limits are given as 10 mA. Whether the load impedance has a high or a low D.C. resistance, therefore, the centre bias position for a class A amplifier should not be greater than 5 mA. Consideration of circuits connected with temperature stabilisation may make it desirable to limit the normal steady current to slightly less than 5 mA.

Permissible collector dissipation as given by manufacturers is 25 milliwatts. it would, therefore, be possible to design the stage to operate from 5 volts at 5 mA without damaging the transistor. Note that, if, in some special circuit, steady collector current were required to be 8 mA, say, the maximum collector voltage you could apply to the transistor without exceeding dissipation figures would be about 3 volts.

STANDARD BATTERY

Since a 4.5 volt battery is already available in our little set, it would be reasonable to standardise on this value for the supply.

Before we can proceed further with the design we need to know something of the characteristics of the headphones to be used with the set. Phones vary somewhat in their characteristics and the impedance of a given pair of phones varies widely with frequency.

It is usual to quote the impedance of

CIRCUIT OF 2-TRANSISTOR SET

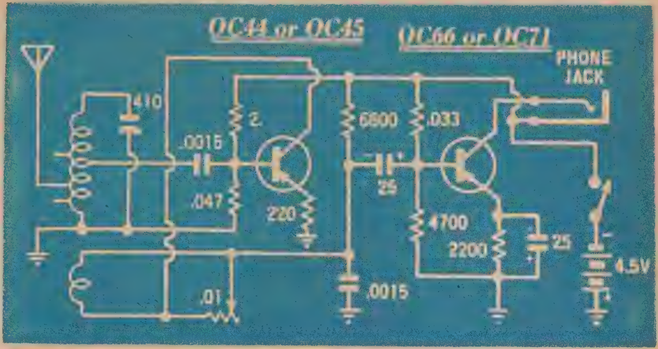
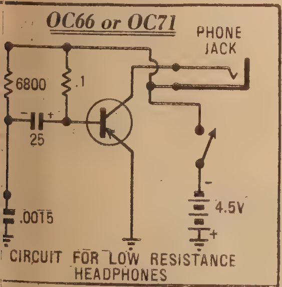


Figure 2: Circuit diagram of the complete receiver with constants suitable for headphones with a DC resistance of from 1,000 to about 4,000 ohms. Circuit arrangements are such that the set will work with full efficiency over a wide temperature range. Total current drain is about 0.3 mA and therefore batteries should last virtually their shelf life.



ure 3: Use this circuit for low resis- ce headphones. It is not suitable high resistance phones and if used h them, will result in small power output and high distortion.

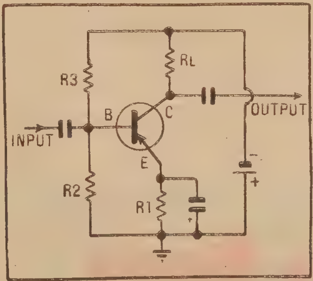


Figure 4: Where temperature changes are likely to affect the standing collector current appreciably, the above stabilising is frequently used.

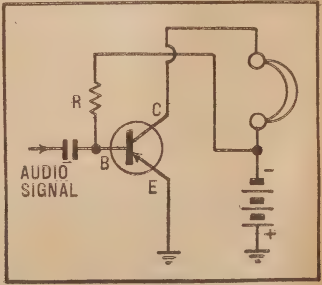


Figure 5: Forward bias is applied to a transistor amplifier simply by placing an appropriate value resistor between the high tension supply and the base.

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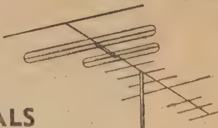

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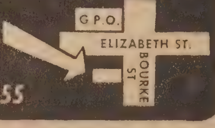

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● *PLEASE INCLUDE POSTAGE OR FREIGHT WITH ALL ORDERS* ad ones in the middle of the audio ng On this basis we found that the pe nce of a typical pair of commer- l ones, currently available in the op is 20,000 ohms. The D.C. resis- nce s 4,000 ohms.

A air of disposals "low impedance" on we checked was found to have i edance of 800 ohms and a D.C. is nce of 130 ohms while yet another e ith a moving coil mechanism had D. resistance of 80 ohms and an pe ance of about 100 ohms.

T last mentioned pair of phones u normally be used with a coupling rmer but there is clearly a case ermining the most suitable opera- nditions for both the 20,000 ohm or and the 800 ohm phones.

E OF CURVES

do this we refer to the transistor or curves (Figure 8) where a load drawn for 4,000 ohms and a 4.5 pply. This is, in effect, a locus . operating points for the tran- o

V must now choose the particular ng point which permits the great- cursion of current between zero t on the one hand and the non- a portion of the characteristic near o oltage on the other. Insufficient ai is available in the curves for the im forward bias to be determined h ccuracy, but it is obvious that it very small.

if for example, the bias is set at 20 o high) the collector will be able s ng less than 1 volt toward zero without distortion while it will le to swing several volts in the e direction.

N t we should have some estimate t optimum conditions for the 800 m hones in terms of power output. be seen from the curves that the ion for maximum power output obtained when the bias is about . If the full power output is not d the bias can be reduced and a in standing current made. For le, with 45 uA current bias the ng current will be about 2.0 mA te of about 5 mA as before.

R UIT ARRANGEMENT

D cussion of the bias requirements e a little vague without a specific arrangement. This we have pro- e in Figure 5. The transistor is con- tl in the common emitter arrange- n with the headphones in the collec- cuit. An audio signal with an undis- rt current waveform is fed into the se hrough a coupling capacitor.

B s is required to be in the same laty as the collector voltage and ore can be obtained from the same t y as the collector supply. If we e a bias current of 45 uA from a lt supply it will be necessary to set a 50,000 ohms.

T value of R in cases such as these n e calculated with small error with- t king into account the voltage drop t en the base and the emitter because small compared with the voltage across R, that is, the resistance be- the base and emitter is relatively a

It is, in fact, of the order of 1,000 for normal collector voltages and as urrents. For low bias currents it is higher than 1,000 ohms but it is always low compared with the value of the forward bias resistor.

This change in value does have some significance as far as audio input signal is concerned and has to be taken into account if the signal at the collector is to be undistorted.

While the circuit of Figure 5 may seem at first glance very similar to that of a conventional valve amplifier, it is soon seen that this is not the case when the circuit values are carefully considered. The audio signal supplying the base of the transistor must have a source resistance high compared with the change in resistance of the base circuit, in order that the current waveform remain undistorted. Suitable values may be of the order of two or three thousand ohms or greater.

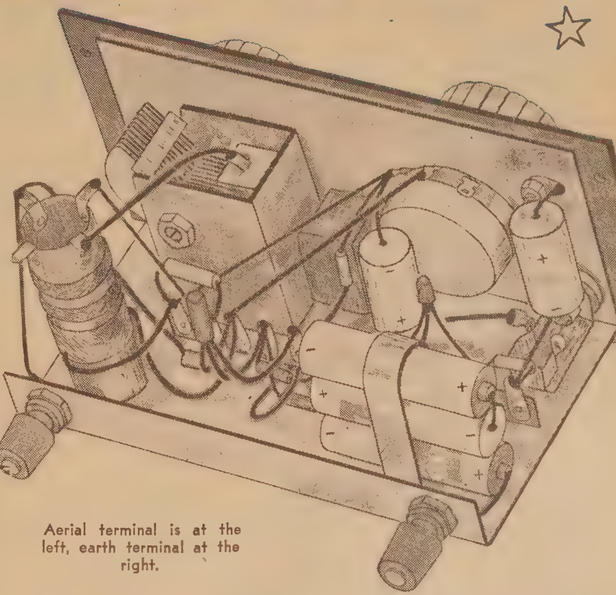
The coupling capacitor between the stages is required to have a low reactance compared with the series impedance of the drive circuit at the lowest frequency it is desired to amplify.

TYPICAL VALUES

Values of several microfarad may be required, compared with the fraction of a microfarad which is usually convenient in valve circuits. These capacitors need not be large physically, because the voltage ratings can be quite low. Special electrolytics have been made for this sort of work and no doubt will become more readily available as transistors are more widely used.

Another factor which complicates transistor circuitry, only mentioned briefly so far, is temperature. It is a subject to which we could, with profit, devote considerable space. For a full understanding it needs to be discussed on a quantitive basis rather than from the

A REAR VIEW OF THE RECEIVER



Aerial terminal is at the left, earth terminal at the right.

Figure 6: This diagram, looking from the rear, shows the placement of all major components in our own version of the set and much of the wiring. Layout is not critical, and there is nothing to stop you from making the set in any box or cabinet you may happen to have.

PARTS LIST

(For use with high resistance headphones)

Small pieces of sheet metal, bakelite and plywood for chassis, panel and cabinet.

Transistors OC44 or OC45 and OC66 or OC71.

Single section minature tuning capacitor, 410 pF. 2 0.0015 uF mica or ceramic capacitors 2 25uF electrolytics.

Potentiometer 10,000 ohms wirewound or carbon. 1 2.0 meg resistor, 1 .047 meg resistor, 1 33,000 ohm, 1 6,800 ohm, 1 4,700 ohm, 1 2,200 ohm, 1 220 ohm resistor. (Resistors may be either ½ or 1 watt.)

Phone jack, minature switch, tag strip, terminals, three dry cells, 2 terminals, 2 knobs.

Coil is wound on ¾in diam. former. Tuned winding is wound to a length of 1¼in with 32 B & S wire and tapped at 1/8in, ¼in, ½in and ¾in. Reaction winding is wound to a length of 3/8in with 36 B & S wire. Alternatively, for extra feedback a 2 layer coil ¼in long. Both 1/16in from earthed end of tuned coil. Both in same direction.

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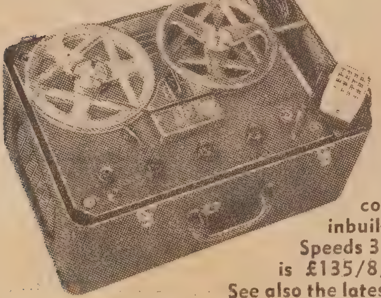

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ry eneral point of view, as so far in is ticle.

It s necessary to say a little more ou the effects of temperature, if only e lain the presence of a number of di nal components in the circuit for e th the high impedance phones.

L king at the collector characteristic mi of curves (Figure 8) it is seen at e collector current is affected both t base current and by the voltage pl d to the collector. The voltage has se ndary effect because of the high na ic resistance of the collector cir- it.

U RENT GAIN

T take a specific case, if the collector te ial is set at 2.0 volts, with the base rr t at zero, the collector current will a out 0.15 mA. If the base current ir eased to 40 uA, the collector current vill increase to 2 mA. In other r , the change in collector current is it less than 50 times the change in se current.

If ow, we increase the collector volt- om 2 to 4 volts, the collector cur- it ill increase from 2 mA to 2.2 mA iy ecause of the high resistance of the le or circuit.

T information applies only at a m al junction temperature quoted by anufacturer. This is usually 25 gr s centigrade (77 degrees F.). If mperature is increased, the collec- rrent for any bias or collector cur- it ill increase. In other words, the ri set of collector current curves will v upwards.

N urally this could not go on with- t nit because eventually the collector r t would become high, even with- rward bias current. and the dissi- ci rating for the transistor exceeded. v usly dissipation and temperature osely connected, but even when r is extremely small power being dis- at, there is a limit to the permissible c n temperature, due to the physical ec on the germanium.

T temperature of the surrounding ll be less than the junction tem- a re, when the transistor is dissipat- s full rated power. Usually the n acturer gives maximum ambient rature when the transistor is dissi- ir its full rated power. In the case t OC71, this is 45 degrees centigrade 3 legrees F.).

C STABILITY

D a is given by manufacturers from ic the actual change in collector cur- it or a given change in temperature n e calculated. The voltage applied t collector does have some effect te temperature dependant collector r t, but in most cases this can be gl ted and the temperature increase ns ered to move the entire set of lle or characteristic curves in the e on of higher current.

O the basis of manufacturers' data, e ange in collector current, when the m rature changes from 25 degrees nt rade to 45 degrees centigrade ou result in an increase in collector rr t of about 1.5 mA.

N w, in our case, the collector circuit sis nce (the DC resistance of the head- o s) is 4,000 ohms. Obviously, with e pply of only 4.5 volts by a simple m law calculation, the current can- t 1.5 mA. What actually happens t t the transistor current increases ti the voltage is about 0.2 volts, and e ansistor characteristic is no longer

LAYOUT DIAGRAM OF RECEIVER

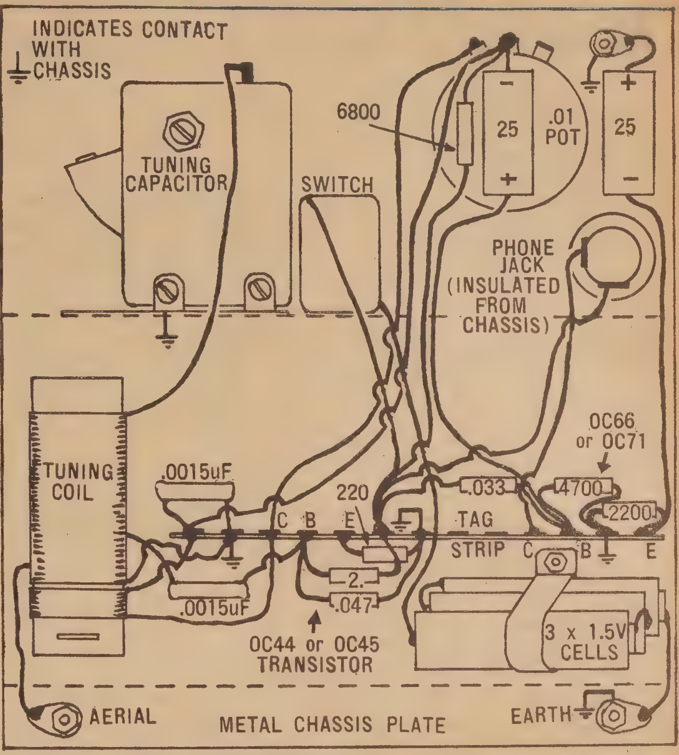


Figure 7: All wires and wiring components are shown in this diagram in which the chassis is bent out flat. Transistors are not drawn to avoid confusion, but their connections are marked C, B & E standing for collector, base and emitter respectively.

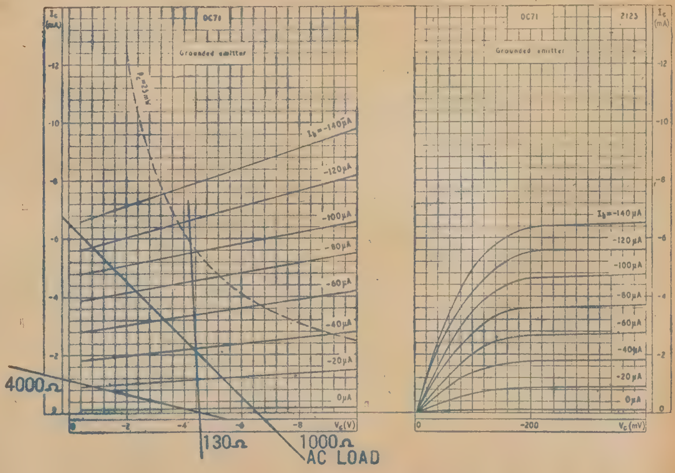
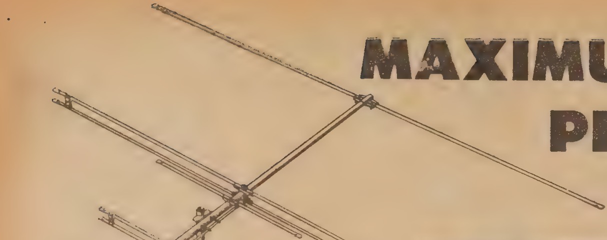


Figure 8: Output characteristic curves for transistor type OC71 from the Mullard Technical Handbook. Load lines illustrate points made in the article. Detailed curve at the right is very useful for designing circuits to work at very low voltages. The 4,000 ohm load drawn from Vc equals 4.5 volts gives possible operating points for high resistance phones. The AC load is not drawn. DC resistance of normal low resistance phones is about 130 ohms and impedance 1,000 ohms. (Not always resistive as shown) It can be seen that max. power output could be increased by increasing forward bias to about −80 uA in the latter case.



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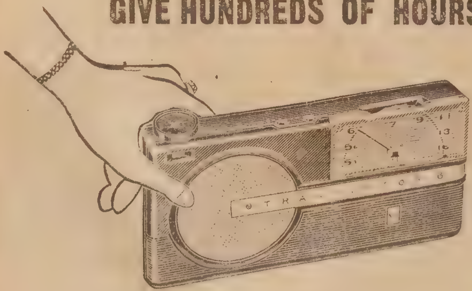

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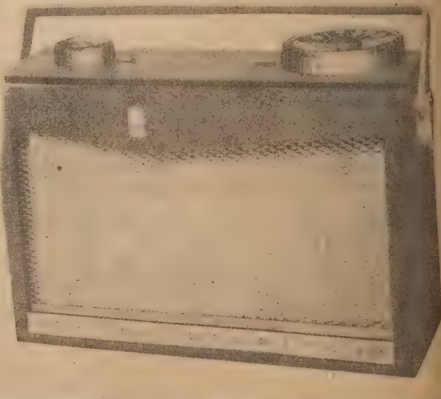

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ar The collector current would then ab it 1.0 mA.

Th transistor remains in this condi- ess a very strong signal is applied ec ce the collector current, in which will reproduce a very distorted id of the input current in the collec- c uit. It should be fairly obvious simple series resistor bias circuit 5) is not suitable for operation hi temperatures, when there is a istance in the collector circuit.

h arrangement frequently used in ct to stabilise the operating point iv in Figure 4, where RL is the sistance. In our case it is an ec nce, since the headphones have an ic e component, but as far as the erating point is concerned, only resistance is of interest.

is roughly analogous with the bias resistor familiar to valve s. Emitter current flowing through sistor results in a voltage drop emitter assumes a potential nega- h respect to ground.

h voltage divider R2 and R3 tends s blish a negative potential for the f the transistor. This potential ary as the base current varies. ount of the variation will depend th values of R2 and R3, the lower ues of the resistors the less the ation.

Ic, if the current through the col- and emitter circuit increases be- se of increase in temperature the a drop across R1 increases, making p ential of both the emitter and the ore negative with respect to earth. s as the effect of reducing the cur- wing in the base circuit and hence at of the amplifying action of the s or, the current flowing in the col- and emitter circuits.

ER WASTE

n other words, it tends to stabilise erating point of the transistor.

e rarely do we get anything for ni in this world, and so it is with stabilising circuit. First of all, e is wasted in the emitter series re- and also power is wasted in the d network. Often it is a question choosing a suitable compromise be- e operating point stability and power te.

ales of resistors for a given current e corresponding with a given tem- at e rise can be calculated fairly di. The circuit we have given for th high resistance headphones is ig d for a normal collector current 0 mA at 25 degrees centigrade, leat 45 degrees centigrade, the for- d urrent will be about 0.3 mA. The is rted power output at the higher p ature will not be as great as at temperatures, but still sufficient gi quite good volume.

Hi impedance phones will give the in, but many will wish to use low ance phones, such as those avail- e rom disposals sources. Since the sistance is low, it is possible to o a forward bias which will make collector current at normal tempera- es igh enough for good power output the same time low enough for the n of normal collector current and k collector current at high tem- at es not to exceed the permissible ue

LOW IMPEDANCE PHONES

For low impedance phones, we suggest a simple forward bias resistor of 0.1 megohms when the collector current at normal temperatures will be about 2.0 mA. No special stabilising circuits are necessary. The current will increase to about 3.5 mA at high temperatures, but the transistor will still be able to deliver adequate audio power without running into distortion.

Addition of the amplifier stage to the small receiver described in detail last month is so simple that special comment is hardly necessary.

If you intend to use the set with low resistance headphones the extra components are the transistor, a capacitor and a resistor. For the high impedance phones, you will need a capacitor and two resistors above this.

In either case, the parts can be soldered to a tag strip mounted between the batteries and the front panel and in line with the earlier tag strip.

Take out the batteries temporarily and mount all components other than the transistor. The coupling capacitor from the collector circuit of the first transistor to the base of the amplifier transistor can most conveniently be anchored between the potentiometer and one of the lugs of the tag strip.

The transistor can be soldered into circuit when you are sure that everything else is in order. Leave the leads of of the transistor fairly long in case you wish to use it later in another receiver or amplifier. The transistor may be damaged by thermal shock and we advise that you hold each lead with a pair of long nose pliers while carrying out the solder job. Leave the pliers in place long enough for the lug to cool, otherwise some of its heat will be transferred after the pliers are removed.

We have heard of cases where transistors have been damaged due to their being soldered into circuit with soldering irons having leakage between the element and the copper bit. Make sure first of all that your soldering iron does not have any obvious leakage and then disconnect the set from all external circuits while doing the soldering job.

The circuit has been designed for either the OC71 or the OC66 transistors and either will work equally well. It is, in fact, an OC66 which appears in the photographs. We have not tried the OC70 or the OC65 but both would probably work well. All these transistors have been reduced in price by a worthwhile amount making the addition of the transistor stage cheaper than adding a valve to a simple regenerative receiver.

RESISTOR TYPES

If you are buying the resistors new, we suggest that you choose ½-watt types as they are cheaper and more compact. At the same time, there is nothing to stop you using 1 watt resistors you may have on hand.

The two coupling capacitors are 25 mfd types rated to withstand a 40 volt surge voltage and are available in several brands. Special compact electrolytic capacitors rated at very low voltages are available and gradually becoming more plentiful. Items of this nature are essential when it comes to building hearing aid amplifiers into spectacle frames and the like, but their extra cost is not warranted in our case.

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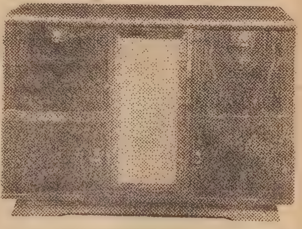

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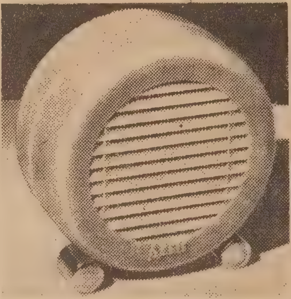

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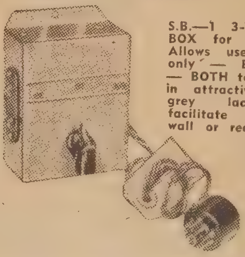

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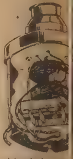

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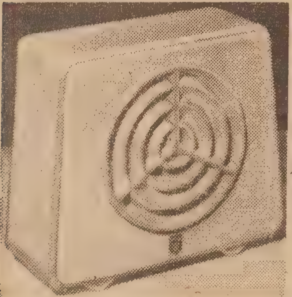

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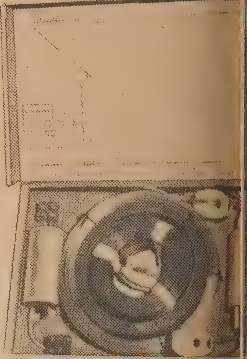

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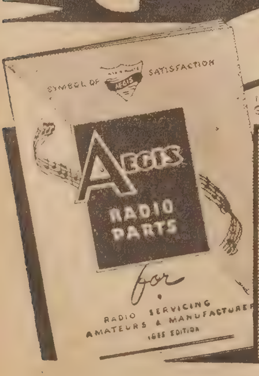

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FROM THE SERVICEMAN WHO TELLS

y prize story this month is not merely unusual but, as far as I'm concerned, definitely unique. erhaps I'm sticking my neck out, but I'll be be very surprised if anything like it has ever been ported before. Furthermore, it could expla in some previously inexplicable "funny effects".

VEVER, the story will make most sense if I start at the beginning. ncerns an American communica- n. receiver which one of the "ham" nity had acquired and which ex- l a most unusual behavior in the circuit, as well as having some ion in the audio system.

er one or two unsuccessful pts to solve the trouble himself, wner passed the set over to an- "ham" who was rather better ped to tackle the job. The latter ned to be a colleague of mine, t was from him that the story ited.

H first impression of the set was t there was certainly something funny" about the AVC system; ect quite unlike anything he had struck before. He described it king the set extremely difficult to accurately, there appearing to be cessive time delay in the AVC but made worse by the fact was not entirely consistent.

AS AND SLOW

s, as a station was tuned in, the appeared to take a long time, i.e., ds, to adjust itself to the incoming while the reverse appeared to e when the station was tuned out, VC adapting itself to the changed ion quite rapidly.

r other words, the AVC was ex- ly sluggish in an upward direc- n but appeared to be normal in a ward direction. Frankly, I can't n of anything better calculated to a "ham" operator balmy in short

the face of it, my colleague could n of no logical explanation as to any AVC system should behave in anner, so he merely adopted the le of checking all components in ne as thoroughly as possible.

thing appeared to be abnormal he commenced checking the by- capacitors for leakage, using the ohms range of a VTVM. The first ition that something was wrong when the meter read backward, in of the fact that the set was switch- ff.

OEIGN VOLTAGE

rther investigation with the VTVM a voltmeter now—showed that was something like three volts ve present on the AVC line, but out any logical source of power pply it.

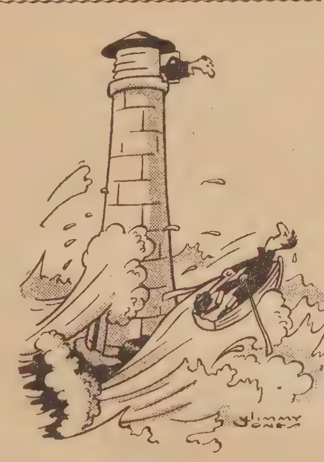
ere followed a systematic unsolder- of leads to isolate completely the from any possible voltages present her parts of the set—but still the erious voltage remained.

wasn't until the AVC line itself broken apart that the culprit was finally run to earth. Imagine my colleague's reaction when he discovered that the voltage was being generated by the AVC by-pass capacitors. There were three in the AVC line and each one would deflect the VTVM when completely removed from the circuit.

Nor was it any residual charge effect. Apart from an initial drop of about 30 pc, the voltage remained essentially constant while ever the capacitor was connected to the VTVM.

Thus alerted, he checked other capacitors in the set, finding one more serving as a coupling device between the noise limiter and the first audio stage. This one wasn't as bad as the others, generating only about half a volt, but this was enough to upset the operation of the audio stage and create the distortion previously noticed.

When he first told me this story, I was frankly incredulous, and I said as much in the special diplomatic language which servicemen and radio technicians reserve for such occasions.



"Sorry, mate — there's no Smith here who wants his set converted!"

"I thought you'd say that," said my colleague. "Come into the workshop and I'll show you."

Whereupon he led me up to the VTVM, handed me the leads and the suspect capacitor, and said:

"There you are, try it for yourself. This one should read about half a volt."

I did. The meter read .5 volt initially, dropping slowly to about .3, at which it appeared to become more or less stationary. I removed it from the test leads, shorted them, checked the VTVM for zero and possible false readings, but could find nothing abnormal.

I measured the capacitor again. It had risen to .45 during the few minutes it had been on the bench, dropping as before to about .3. Muttering something about fixing the thing properly, I removed it from the meter once more and bridged the two pigtails with a scrap of tinned copper wire on the bench.

I left it in place for half a minute or so, then put the capacitor back on the meter. It read .15 volt.

"Satisfied?" asked my colleague.

I shook my head, not as an answer to his query, but in straight out bewilderment. "You win," I replied. "But I still can't see how it happens."

He shrugged his shoulders. "Nor I. All I know is that it is happening and that it gummed up that communications set. I'll leave the reason for someone else to explain."

STILL GENERATING

That was several days ago. As I write, the same capacitor is resting on my table. I checked it again on my own VTVM a few moments ago and it swung the needle up to .5 volt, then dropped much as it did before. Presumably, it is likely to go on generating voltage for a long time yet.

And the reason behind all this? Well, it's easy enough to see—now—why the AVC line behaved so erratically. Before the negative voltage generated by the diode could become effective, it would have to discharge the positive voltage generated by the capacitors and then commence to build up the required negative voltage. No wonder its response was sluggish.

Presumably, the energy in the AVC line was high enough to maintain something like the correct bias while ever the station was tuned in, but reverted rapidly to the positive bias condition immediately this was removed. Hence the apparently normal AVC response in the downward direction.

WHY DOES IT HAPPEN?

As for the capacitors themselves—well, I'm afraid I pass on that one for the moment. My first reaction was that acid content in the insulating paper could be acting as the electrolyte for a crude cell. Unfortunately, the flaw in this theory is that both plates of such a cell would be of identical material. This being so, how could a potential difference be produced?

I rang a couple of acquaintances who work in local capacitor factories and who should, by virtue of their respective positions, be well acquainted with such phenomena if it is at all common. Both assured me they had never heard of it before and both expressed an eagerness to submit my sample to a laboratory test.

Since I personally had only one such

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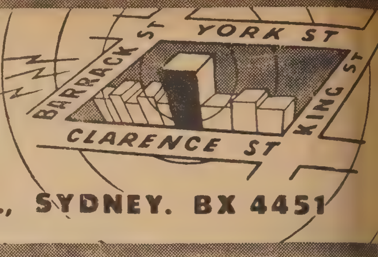

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they may have to fight it out them, but I am hoping that I able to get some kind of an ion for the phenomena.

e meantime, I have been con- my own private witch hunt. g a handful of new capacitors he workshop bin, I submitted l to the VTVM test. Strangely most of them showed some of voltage, even though it was gible amount.

few cases it was comparable e one I have been discussing, ne specimen sent the needle hard ist the 3-volt mark at the end scale.

ever, in all cases the voltage dropped to virtually zero, and ot be sure whether the effect e to a trace of energy left over he final test, or whether it was erated. The three-volt one, at oks as though it might be one latter. I have shorted it out f an hour or so and intend to for a day or two to see if it quire a charge without assistance.

THE SAME

ny case, none of those that I sted have been the same as the , inasmuch as they all exhibited high internal resistance and er voltage was present dropped apidly. They would be hardly to upset the performance of a .

it may mean something to capa- nanufacturers, who see in such behavior possible evidence of lysis or dissimilar-metal effects might ultimately react on the and life of their component.

here, for the moment, the matter As I said at the beginning, it ompletely new fault as far as I cerned, though I am prepared to that someone will come up with lar experience. All I hope at ment is that none of these "live" ors—if they exist locally—find vay into the current crop of TV rs. That, I imagine, could be a nasty one.

ging to the other end of the my next story concerns nothing retentious than a crystal set. The act that I don't have to service levices very often adds some in- to the story, while one of the of failure was rather unusual.

CAL JOB

so often happens, this incident outside office hours, while on a call. My host was a fellow who abbled in radio to some degree, to the extent of building a few receivers and amplifiers, thereby ing at least a rudimentary grasp sic principles.

asn't altogether surprised, there- when he waited only long enough change the usual polite pleasan- efore he exclaimed, "I've a curly radio problem all lined up for You'll have to earn your after- tea today."

I say, I wasn't surprised at this, quailed inwardly just the same. his TV set? (he had just acquir- e), or was it his car radio? (he ne of those, too), and what was about it? At that particular nt, I had never felt less like tack- an intermittent in either a car or a TV set.

Some of my inward reaction must have shown, because he grinned and added, "Oh, it's not that bad, really, just a rather puzzling behavior on the part of the boy's crystal set. But the trouble is, I hardly know where to start checking. After all, there's nothing in the thing."

Then I remembered. His son—a lad between the age of picture books and long pants—had recently shown an interest in radio, electricity, and kindred subjects, and his father had wisely encouraged him in his hobby.

The first project was a crystal set and, with a discreet amount of help from Dad (both financial and technical) the lad had made quite a good job of it. The last I had heard it was receiving several local programs—separately—and had been installed in his bedroom as a bedside set.

Now, apparently, it was on the blink, and I must confess that I felt much the same as my host about the problem. Just where does one start to check a crystal set? Apart from obvious things which can be checked visually, there isn't much that can go wrong, particulary in a set that has previously functioned successfully.

All of which, seemingly, suggests a rather contradictory situation, whereby a crystal set becomes a difficult set to service because there is so little in it that one can check. This is not really true, of course, but it is true that checking a crystal set presents its own particular problems.

LITTLE PRACTICE

For one thing, very few of us have the chance to acquire sufficient practical experience on these simple sets. Thus, when faced with a problem, we have no standard against which to judge performance. For another, performance is so dependent on location, efficiency of the aerial-earth system, condition of the phones, etc., that it is difficult to decide whether the fault is with these things, the set itself, or combination of both.

In the circumstances I reasoned that a faulty detector would be a most likely diagnosis, even though these are usually pretty robust. I said as much to my host as we made our way to the set, but he rather dashed my hopes by pointing out that he had already thought of this and had tried two other detectors without any improvement.

By this time we had the set in front of us and I gave it a quick visual check. There didn't appear to be anything obviously wrong and I slipped the phones on and twiddled the dial. I managed to pick up one station—a nearby one—but it was extremely weak and badly distorted into the bargain.

Then I raised the question of the detector again. The one in the set at the moment was one of the early copper-oxide types, diodes, which, as I remembered them, were rather less efficient than the modern germanium types.

The first thing I wanted to know was where it came from and what chance there was that it was any good, anyway. To this the lad replied that it was one of two which had been passed on to him by a well-meaning friend who had come across them while clearing out some old radio gear. Then he added:

"It used to work best with this white one. That was the one I put in it first. I could hear the bloke next door with it, as well as the proper stations."

"The bloke next door?" I queried.

"HAM" SIGNALS

"There used to be a 'ham' next door," explained my host. "He's moved away now. He used to put a solid signal into the crystal set when he was on 80 metres. Not surprising really, seeing that our aerial was parallel with his and only a few feet from it."

"What about the other one you were given?" I asked.

"Oh, it won't work at all with that one," said the lad, "and it only just works with the one in it now."

"And the white one?"

"Doesn't work at all with that now, either," he replied.

By now a possible theory was beginning to form in my mind. First, there seemed more than a chance that the two copper-oxide diodes had "had it" even before they were passed over to the lad. If this were so they would only have clouded the issue when used as a basis for comparison.

The second point was the very real possibility that the blast of signal from the "ham" on 80 metres had proved too much for original germanium diode, bringing about the failure of what should

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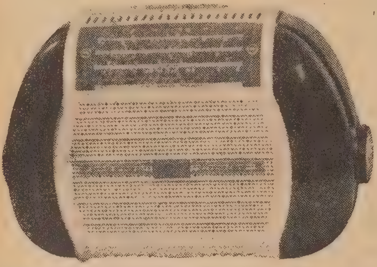

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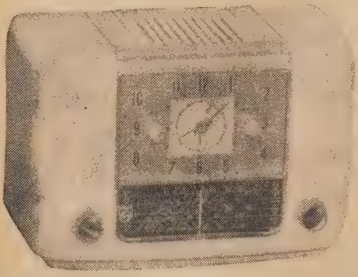

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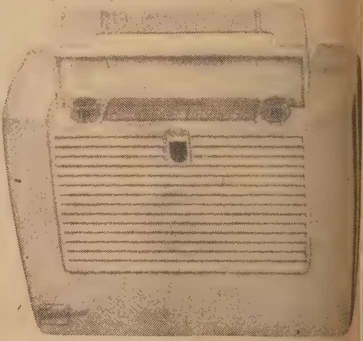

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THE RADIO MART

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the ise be an almost everlasting de-
ce.

I pounded this theory to my host and gg ed that he let me take the set and e ortment of detectors back to the ork iop. At least I could try the set ith known good diode, and compare e rformance with that of the sus-ct nes. Until then there didn't seem b much more I could do.

"d," I added, "you'll have to give y afternoon tea on trust after all."

B k at the workshop next day I e d the best aerial I had, plus a earth, and tried the set again. Its mance was much as before, still n the original copper-oxide diode. matter of interest I removed this d hecked it on the ohm meter. In e irection it showed 4500 ohms and other open circuit; figures which mean a great deal at the time.

HER RESISTANCE

H wever, I checked copper-oxide diode (the one that was supposedly dud) d ound it had 75,000 ohms in one ion and was O/C in reverse. Well, st that seemed logical. To prove the I wired it into the set and con-d the lad's story that it was useless.

N xt I checked the germanium diode, to find that it was completely O/C h directions. In these circumstances didn't seem to be much point in ing it in the set.

ving thus established some basis comparison I fished out a couple ermanium diodes I had on hand ut them across the ohm meter. No. of uncertain age and origin — ured 500 ohms in one direction 5,000 in reverse. No. 2 — a brand one — did even better; it showed ohms one way and 250,000 ohms verse. Both these figures seemed logical than the previous ones.

the set, No. 1 performed many better than the defunct copper-, and more in the manner that I cted a crystal set to work. No. 2 even better, though the difference not oustanding. Still, the fact that as noticeable was significant, and lished the validity of the ohm meter in terms of probable performance, ast on a rule-of-thumb basis.

ter that afternoon an excited school-who had hurried around from school spec." put on the phones and listen-d o his set. He twiddled the dial, ked the number of stations he could e, listened intently to each one, then d:

Vhat was wrong with it?"

faulty crystal," I replied, then d, "How do you like it now?"

w gee, its real beaut."

nd that, from any schoolboy, is rise indeed.

C R TROUBLES

o round things off for the month e is a simple incident from real life. was pottering around the garden on a recent Saturday afternoon, when I be me aware of a couple of energetic ty s out in the street, working on a ca By their voices I identified them as near neighbours who had recently ac ired a not-so-new car.

(Continued on Page 120)

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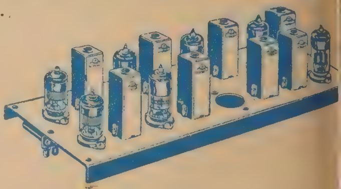

REMEMBER—THERE IS NO TEST EQUIPMENT REQUIR

"Q-PLUS" F.M. Coils & Transformer

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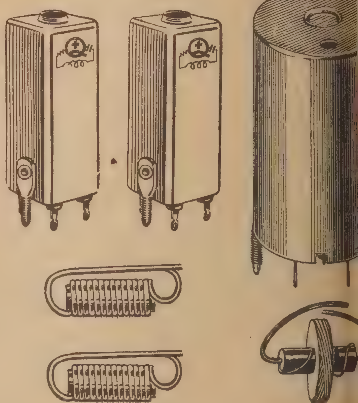

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A READER BUILT IT!

Gadgets and circuits which we have not actually tried out, but published for the general interest of beginners and experimenters.

ESIGN FOR RESISTANCE CAPACITY RUMBLE FILTER

A eader from Bulimba, Queensland, Mr. H. Swan es regarding his experiences with a commercial ord player fitted with a crystal pickup. He ced that on certain microgroove recordings, re the gain control had to be advanced, the uble level was too high for pleasant listening and nd the solution to his problems in a resistance capacity network.

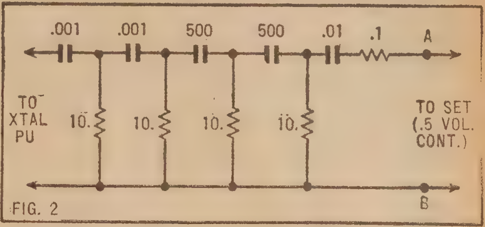


FIG. 2

SWAN tells his own story: "At he end of last year I built up a ram following the circuit of the -Band Six" with some modifica- o the audio end. I used a pair of Stentorian speakers (woofer and tweeter with crossover) and a commercial record player with a crystal pickup.

Everything worked out perfectly but for one fact. The record player proved to have a certain amount of inherent rumble which was very annoying on low level microgroove records.

As record players don't grow on trees, I set to work to design a suitable rumble filter and came up with the accompanying circuit (Figure 1) which did the job very effectively.

The whole device was built up in a metal box fitted with a pair of terminals for the input and a short shielded lead for the output.

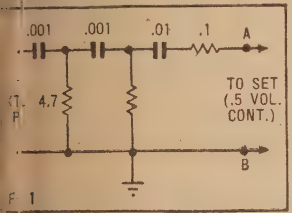
Anyone who would like to get rid of the treble pre-emphasis on microgrooves could try connecting a 500 pf capacitor between A and B.

For an amplifier fitted with a 1 meg. volume control the 0.1 meg. resistor in the "hot" output lead could be omitted.

As a matter of fact, if my calculations are correct, this network gives approximately an RIAA roll-off to the bass.

This circuit (Figure 1) should be all that is required with any single ended amplifier as most of these drop off very steeply below 30 c/s. Anyone with a push-pull amplifier would be well advised to use the larger network (Figure 2).

Knowing the number of people using motor pickup combinations with extended range amplifiers I feel sure that many of your readers will appreciate the information.



F 1

SIMPLE AMPLIFIER FOR A CRYSTAL SET

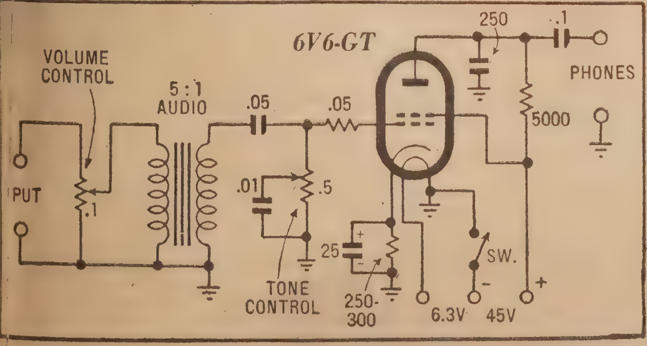
STER IAN WILSON, Bensville, via Woy Woy, NSW, writes: "I se a circuit of my own design for all one valve amplifier that you find fit to publish in the "Reader It" columns of your magazine.

" found that the amplifier works ex- ly well on a crystal set and could sed on small one or two valve sets. n easily be constructed on a chassis uring 5in x 4in x 2in."

ltages are not critical, the greater igh tension voltage the greater the mum power output. Actually the 6V6-G is frequently used as a power output valve in mains operated receivers where the high tension is up to 250 volts.

The valve would probably work quite well with the filament on a 5 volt supply. On the other hand it should not exceed 7.5 volts.

For greatest voltage gain the audio transformer could be connected the other way around although the change would have an effect on the frequency response. Finally, the .05 mfd capacitor in the "hot" secondary lead may not be necessary.

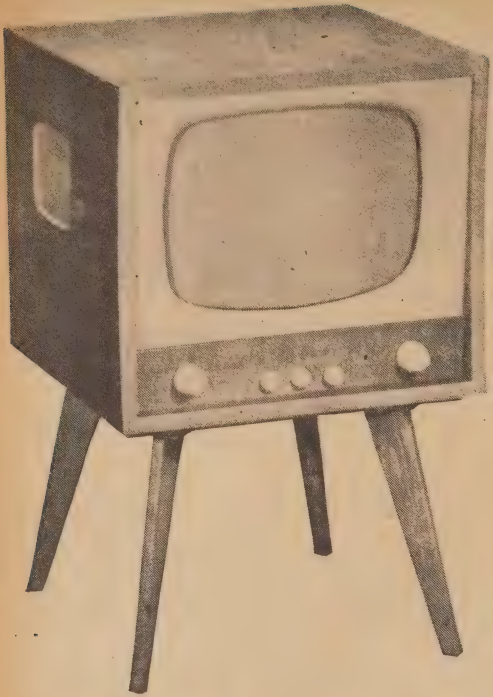


USING OLD FLUORESCENT TUBES

IT is still possible to use fluorescent tubes which have the filament burnt out. While not an economic proposition in the normal way, there may be some readers who happen to have the parts on hand and would like to use tubes which have been discarded because one or both filaments are burnt out.

Mr. B. Sargent, of Earlwood, NSW, suggests connecting the tube across the 770 volt full secondary of a power transformer in series with an ordinary filament type lamp to limit the current to a suitable value. (Obviously, the tube cannot be used without some limiting device, otherwise an enormous current will flow).

For a 40 watt tube Mr. Sargent has found that a 60 watt filament lamp is suitable or a 30 watt lamp for a normal 20 watt tube. Connect the filament pins together at each end of the tube.



Here is the cabinet design we suggest for your co pleted receiver. It can be built without special skill special tools and shouldn't cost more than five or pounds. The knobs are standard radio types, whi can be adapted easily for use with this receiver. T design is already being copied and adapted for co mercial sale.

PART THREE

OUR 17-inch TELEVISION SE

Here is the third and final major article on the RT & H 17-inch television receiver. It details construction of the cabinet, mounting arrangements for the picture tube and the fina setting up of the receiver to ensure optimum results.

ALTHOUGH presented as the last major article, this will certainly not be our last word on the receiver. On a project which is so new and of such magnitude, readers are likely to raise many points about construction and adjustment which have not specifically been covered in the original articles.

Assuming, however, that you have completed wiring of the chassis, as described last month, the next step is to build the cabinet and thus provide a safe housing for the picture tube during final testing.

If you choose rather to test the set with the tube propped up on the table, you do so at your own risk!

CHASSIS MOUNTING?

Some readers, alternatively, may decide to mount the picture tube on the chassis itself, as in many commercial receivers. Since we have not adopted this method, we are not in a position at this stage to make any specific recommendations about the best way to go about it.

However, if you have ideas along these lines, it would be a wise precaution to examine methods used in commercial receivers.

The usual method is to clamp the tube around the front edge of the bulb, with rubber or felt cushioning to distribute the pressure. The yoke is supported independently but linked to the front clamp to ensure rigidity. No strain must be placed on the neck of the tube.

With the tube attached to the chassis, it is often necessary to provide additional metalwork or a cradle, so th chassis can be rolled over for work underneath. C necessary, also, to avoid scratching the tube or hitti accidentally with tools.

In the cabinet design, illustrated above, the botto the tube face is about 1 7/8in above the surface of the c which should allow ample room for a cradle, while allowing the tube to clear the tuner.

Manufacturers expressly stipulate that picture tu should not be exposed or handled unless all persons the vicinity are wearing shatter-proof goggles.

While, in practice, the stipulation appears to be hon more in the breach than otherwise, it stands neverthele

It was largely to avoid these complications tha mounted the tube as we did.

COMPLETELY NEW CABINET

As you will see from the accompanying photograp have completely re-styled the cabinet, so that it is both m and attractive in appearance. It incorporates the le learned in the design illustrated in earlier issues, yet is ac simpler to construct. Properly finished, it is worthy of a in any lounge room.

In revising the design, we have brought the knobs the front alignment of the cabinet, reducing the length control shafts by a full inch. This makes it possible t a standard tandem pot. for the "Gain-Brightness" co with an approximate 2-inch outer and 2½-inch inner sh

The same reduction applies to the tuner shafts over-rides earlier remarks on this point.

Apart from being mechanically helpful, the new pos for the knobs and a concave finish to the front vertical of the cabinet give the set a neater, more compact appear

TWO POSSIBLE POSITIONS

The speaker can mount on either side of the ca depending on which position best serves the viewing Alternatively, you may choose to fit two speakers, oper them in parallel but with the cones phased to give rein ment rather than cancellation at the bass end.

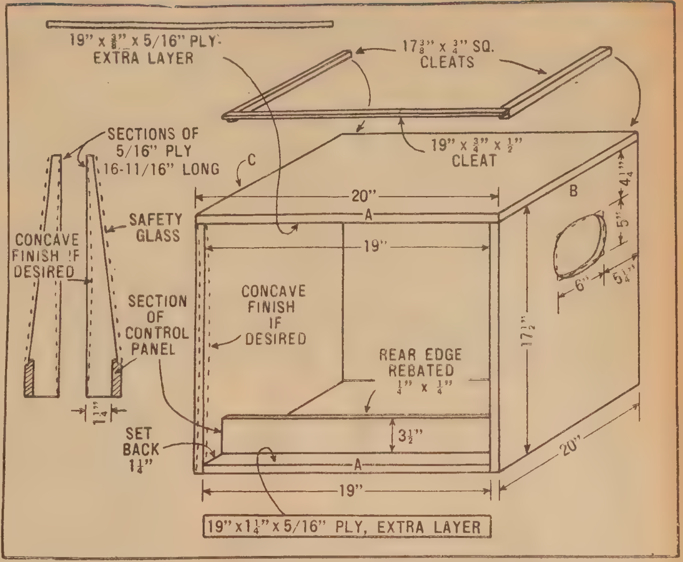
To build the cabinet, as illustrated, you need only a 6ft x 3ft sheet of half-inch plywood, plus a few addit scraps that will not worry any home handyman. In fa you make or buy a set of "Swedish" legs, enough plywoo be saved from the full sheet to make a table or "swivel- to carry the cabinet in the modern mode.

The cabinet in the photograph is resting on just su table.

Whether you follow this design in detail, however, matter of personal choice. Some may prefer to buy timber and build a full or semi-console style, with the sp below the receiver proper and facing forward. The same mounting arrangements and the same dimensions ca used for the chassis shelf, the tube and the safety glass.

Again, the cabinet could be widened and the c mounted vertically against the right-hand side. This bring the tuning controls to the top right-hand corner

BASIC DIMENSIONS OF CABINET



This sketch gives the basic dimensions for the cabinet. To conform with the modern styling, all corners should be finished square and sharp. The front edge of the cabinet and the edge of the speaker cutout should be filled and lacquered to provide contrast and to hide the laminations.

the other knobs in line below it. It would be a rather drastic rearrangement but practical nevertheless.

The job of building the cabinet will be speeded and simplified no end, if you can borrow an ordinary ¼-inch electric drill with rotary saw attachment. Provided the blade is properly sharpened, you'll have no difficulty in cutting any plywood or cleats that will be required.

Over and above this, you will need only ordinary bench tools, a serviceable vise and space to work.

Choose the sheet of plywood personally, making sure that it is flat, suitably figured without violent contrasts in colour and pattern, free from surface imperfections and, above all, well glued between layers. We used maple ply and, by cleaning bench and floor beforehand, made sure that it would not be disfigured during handling.

CUTTING THE SHEET

The accompanying diagram shows the suggested method of cutting up a ft x 3ft sheet. The dimensions given are for the finished sections and allowance should be made for cutting and dressing. Use a hard, sharp pencil and an accurate T-square for marking out.

With a rotary saw it is possible to work almost to the pencil line by running the saw body or guide against a straight-edge clamped to the sheet. Hardly any additional dressing of the wood should be required.

With hand tools, the same accuracy is not possible for an amateur and at least one-sixteenth inch should be allowed for dressing with a sharp finely set plane. Make each cut as accurate as you can, so that you will leave a reasonable edge for the adjacent panel.

When planing an edge, work from both ends towards the centre to avoid the risk of chipping corners.

Cut out the top of the cabinet first, choosing an original accurate edge for the front.

The two sides can be marked out next, as indicated.

The styling provides that the front edges be curved slightly inwards, to a depth of about ½-inch. We marked the rectangle first, then described an arc between the front corners by swinging the pencil at the end of a 0-inch length of cord.

Note that the sides are marked out with the concave surfaces opposite, so that the same side of the ply will ultimately be outwards in each case. Cut the two curves with a keyhole saw as the first operation, then cut the panels from the sheet. The straight surfaces can be dressed square but leave the finishing of the concave surface till later.

The bottom of the cabinet is made up from two narrower strips, in order to use the unbroken surfaces for positions where they will be seen — or needed. The two pieces can be cut out and the two mating surfaces dressed till they meet along their whole length. The edges which will ultimately butt against the sides of the cabinet should also be dressed square, ready to assemble.

The edge which will ultimately face the rear of the cabinet should be inset for most of its length by about ¼-inch. This will accommodate and support a removable internally-fitting back for the cabinet, made from ¼-inch plywood or composition board.

At this stage, you will need some casein or other carpenter's glue and a couple of short lengths of 7/8-inch square, dressed stock for cleats to strengthen the butt joint between sides and top.

FITTING THE SIDES

Lay the cabinet top upside-down on the floor and stand each of the sides upon it, in turn. Line the sides up with the edge of the cabinet top, leaving a small margin for dressing, then mark along the inside with a sharp pencil.

by Neville Williams

Cut the two cleats to length, drill three holes through them each way and countersink. Working to the pencil lines just marked, screw the cleats to the underside of the cabinet top, using screws which will drive well into the plywood without endangering the outer surface.

Note that the cleats stop about 1½-inch short of the front of the cabinet. They also end ¼-inch inside the rear edge to provide top support points for the removable back already mentioned.

The sides can now be screwed into position, allowing the top panel to protrude at the front by the odd sixteenth-inch shown in the sheet cut-up diagram. The surplus will be dressed later to the contour of the vertical front edges.

Make sure that the top can be dressed square with the sides, that the sides tend to stand exactly vertical and that the butt joint is flush along the outer surface. If not, now is the time to correct any errors by judiciously planing the cleat.

Having checked on all these points, take the whole thing apart, coat all relevant surfaces with glue and screw tightly together.

The two sections of ply forming the bottom can be pinned together at this stage by dowelling, or by drilling fine holes in the centre ply and driving two or three 2-inch nails, minus their heads, halfway into each ply. Coat the edges with glue before you push them together.

See that the bottom section butts neatly between the sides. If all is well, coat the mating edges with glue, place in position and secure with half a dozen long panel pins through each side. Drive them at opposing oblique angles and punch the heads below the surface to allow for subsequent filling.

CONTROL PANEL

Next step is to make the small control panel, which should be squared and dressed to be a precise fit in the position indicated. Drill three holes through the bottom of the cabinet and countersink so that screws can be driven through into the bottom of the panel.

The top rear edge of the panel should be rebated ¼ x ¼-inch, forming a ledge to support the safety glass. Sand smooth, and round the front edge slightly.

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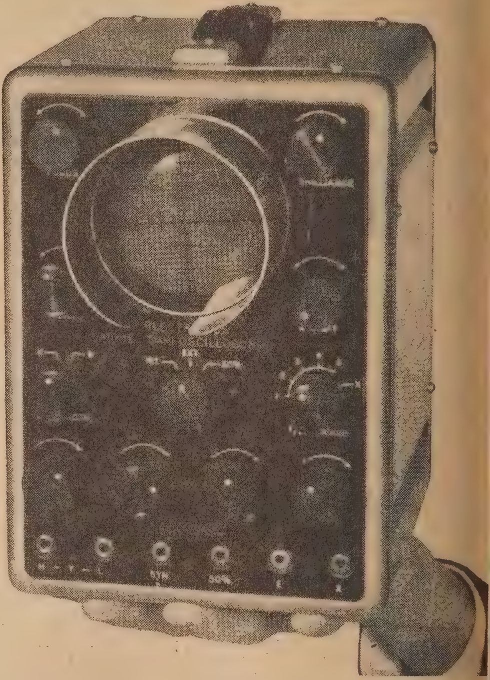
ELECTRONICS

MODEL TV-1 OSCILLOSCOPE



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A compact, direct coupled oscilloscope for television servicing and installation.

Latest 2¾" Cathode ray tube . . . technically sound . . . lightweight, portable unit. Push-pull vertical and horizontal amplifiers.

Specifications —

Vertical Amplifier: 2 position switch for choice of gain/bandwidth conditions. Push-pull amplifier gives a symmetrical undistorted picture.

"N" position . . .

sensitivity 50 mV/Cm. D.C. to 100 Kc/S. (—3db).

"W" position . . .

sensitivity 500 mV/Cm. 20 c/s to 3Mc/S. (—6db).

Deflection is not limited in the "N" position and the undistorted amplitude may be expanded to more than fill the screen. In the "W" position, the undistorted amplitude is limited to a height of 2 Cm (¾") which is quite adequate for the examination of television pulses.

In addition to a gain control, alternative input sockets are provided, the "H" position utilising the total amplifier gain, with a D.C. input resistance of 0.5 megohms.

The "L" (low) gain position provides an attenuation of 20 times with a D.C. input resistance of 10 megohms and is frequency compensated.

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3682

Th done, coat the bottom and sides with lue and push into position. Drive rews through from the bottom cure the ends with long panel pins, through the sides and punched the surface.

T safety glass is intended to rest rebate just mentioned and behind tra layer of plywood around the edge of the cabinet. For this extra we suggest scraps of 5/16-inch alf-inch ply may look too clumsy, ¼-inch may not be sufficient to ny inaccuracy in cutting the glass ask.

F t cut a strip of the ply to fit along ttom edge of the cabinet, in front e control panel. Cut it slightly ze so that it can later be dressed with the bottom edge.

D STRIPS

the sides, two rather oddly shaped are required. The rear edge in case, must form a line between the in the control panel and a point nore than 3/8-inch behind the ed, dressed front of the cabinet his ensures a pronounced forward r the safety glass, minimising re- n troubles when the set is in use.

n't worry overmuch about the surface of the extra strip, as it can it later to conform with the con- sides, using a coping saw.

it and pin the bottom strip to the strips, paint with glue and pin the bly to the cabinet front with short . Finally, add a narrow strip along op, in line with the rear edge of wo sloping sides. You should now a flat frame against which the glass can rest, and the exact nsions required for the glass can be ured.

this stage, pin-holes or other im- ctions can be filled with putty or c wood and the cabinet put aside he glue to set before finishing.

The safety glass is employed iversally to protect the tube m the onlookers and the on- kers from the tube in case of cident.

rspex sheet (or similar) is not re- nended because it tends to scratch and may shatter under impact, cularly when cold.

ES OF GLASS

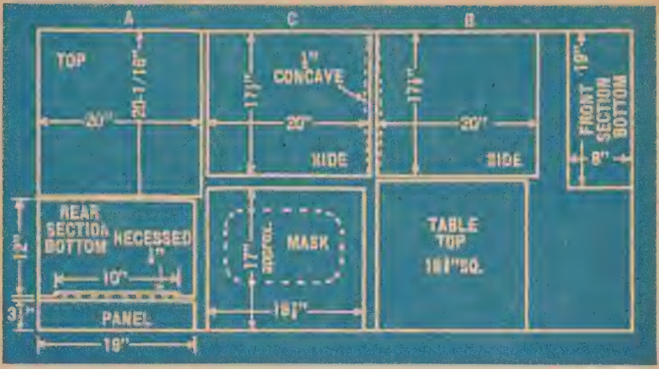
dinary plate glass could be just as erous as the glass of the tube lope but heat-treated or "armoured" is often used. The main disadvant- is that it has to be cut before heat- ing and cannot be modified there- .

obably the best choice for the e constructor is ordinary laminated y glass, as used in windscreens of l cars. It can usually be obtained glass merchants and cut to size on spot.

way of guidance, the safety glass the prototype cabinet measured /8-inches by 18 7/8-inches.

hen the glue has set, the cabinet be dressed down ready for its final 1. Using a sharp, finely set plane, ve the overhang from the butt , keeping all corners strictly square. careful not to disfigure the sur- layer on the two sides, the outer ply often being no more than one-sixteenth inch thick.

HOW TO CUT PLYWOOD SHEET



If you cut up your 6 x 3ft. plywood sheet according to this diagram, you will have enough to build the complete cabinet plus a table or swivel base on which to rest it. Cut the panels as you need them, marking the next panel from the new edge.

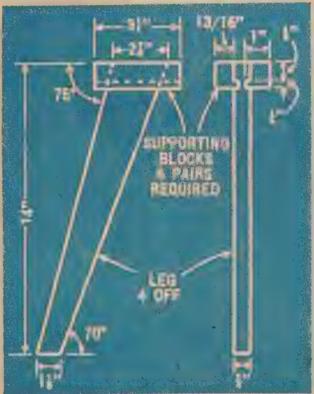
Plane from the outside towards the centre and see that the cabinet is supported against a suitable upright, so that the planing thrust will not fracture any glued joints.

The front edges of the cabinet should be dressed last, using a coping saw, plane and sanding block as necessary. The top and bottom edges should be inclined to continue the contour of the concave sides.

This done, the whole cabinet can be sanded smooth. If using a sanding disc in a drill, choose a fine grade of paper to avoid circular score marks, which can pick up wood stain in a painfully obvious fashion.

Before the cabinet can be surface-finished, one or more suitable cutouts have to be made for the speaker—or speakers.

Ideally, the proposed position for the speaker should be checked practically with the picture tube in its final position, and with a test pattern on the screen. Sliding the speaker in alongside it will soon show whether or not the strong magnetic field is going to distort the image.



You can buy a set of Swedish legs ready made for about £1, or you can make them yourself from scrap wood. Here are the essential dimensions.

Some slight reaction is inevitable, but mounting positions — or speakers—should be avoided which noticeably distort the pattern.

Using the type of speaker mentioned previously, an optimum position was indicated which would have brought the speaker cutout too low down on the side of the cabinet for a balanced appearance.

POSITION FOR SPEAKER

We compromised by placing the cutout as shown, and mounting the speaker as low down as possible behind it, without actually uncovering the corners.

The cut-out shape resembles somewhat a picture-tube mask. While developed from a rectangle as shown, the corners were cut to a one-inch radius, while the sides were contoured to a thirteen-inch radius. The edges were kept sharp to match those at the front of the cabinet.

As mentioned earlier, the prototype cabinet has matching frets on either side, backed by gold-coloured expanded aluminium.

Actual finishing of the cabinet surface can well be the last job done on the receiver, but can logically be mentioned here. The preferred method will vary according to the ideas and aptitude of the individual constructor.

We used a method which gives a very acceptable result without requiring any special skill. From a paint store, we bought a small tin of oil stain of the appropriate color and applied one coat, using a pad of soft cloth. A pad spreads the stain far more evenly than a brush.

A second coat, applied next day, brought the wood to the required color density.

When this dried, the cabinet was given a first coat of clear brushing lacquer, care being taken to guard against

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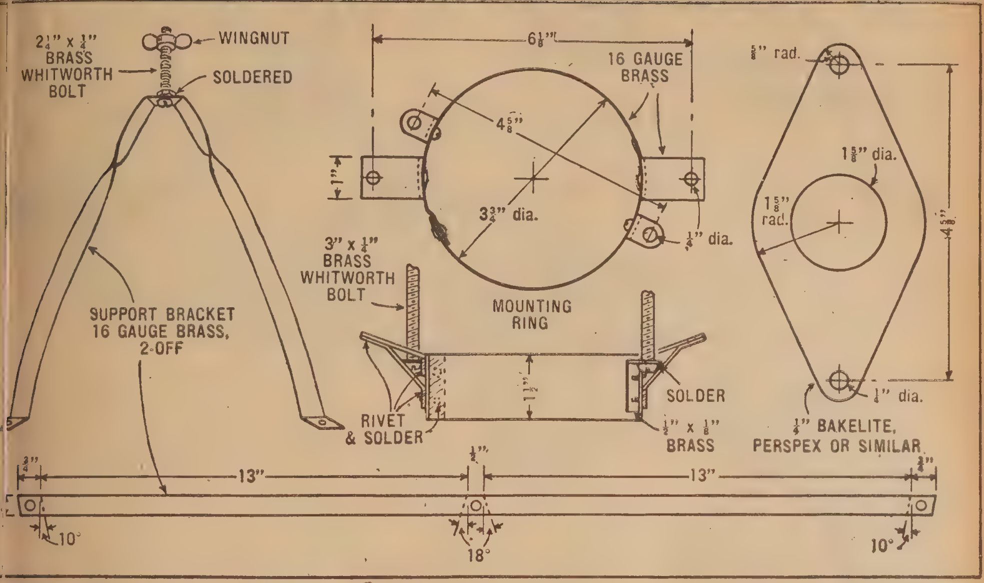

Brkets and locking ring, fabricated as shown will hold the picture tube and deflection yoke securely to the mask plate, wich locks, in turn, into the cabinet. Again, no special tools are necessary to make up these parts. It is merely a matter of time and work.

s and moths. The cabinet was in is condition when photographed, but e intention is to cut it back and apply f ther coat (or coats) as necessary.

e front edges of the cabinet are s lacquered to hide the laminations. lk-chocolate colour is a good choice r cabinets stained light to medium. darker finishes use a deep choco- or brown lacquer. The same lac- can be applied around the inside e speaker cutout.

SK PLATE

much for the cabinet finish. The major item is the mask plate and nbly which supports the tube.

course, if you have already nted the tube on the chassis, your s at this stage will not be very oner- It will only be necessary to de- a few simple cleats to hold the y glass in place, together with some r of a mask. At the time of writing, mercially made masks are be- ing available, needing only to be med to size and locked in behind safety glass.

e original design provides, how- , for the mask, tube support and ing brackets to be assembled as a plete unit.

rst step is to cut from the remain- ½in plywood the section marked for mask plate. Trim it carefully so it will push forward flat against the ty glass, making a neat but not tight against the four inner surfaces of cabinet.

½ x 1in cleat should now be glued screwed to the underside of the net top in a position such that the k plate will just wedge neatly between it and the safety glass, holding the latter firmly in position.

Since the thrust at the bottom is forward and down, with the tube in position, a couple of small angle-brackets bolted to the bottom corners of the mask plate and screwing to the sides of the cabinet will hold it firmly in place.

At this stage, the holes can well be drilled for the controls, through both mask and cabinet front.

Push the chassis into the cabinet, without the mask or glass in position and note where the shafts butt against the inside face of the control panel. Check for symmetry, then drill clearance holes for all shafts.

This done, remove the chassis, put the glass and mask plate in position and run a drill straight through the latter from the control holes in the front panel. The holes in the mask plate can then be enlarged further, to ensure ample clearance.

CUTOUT FOR SCREEN

Next step is to make the cutout for the tube face, in the position indicated, using a keyhole saw. The exact shape of this cut out can be derived, if desired, from the tubemaker's bulb-dimension diagram.

Alternatively, the exact shape of the tube can be obtained by resting it face down on the mask plate, on the floor, and marking around the shadow which the tube casts from a single light globe on the ceiling immediately above it. Then mark a new line about 3-8in inside the original and cut to this.

Note that the tube face should not pass through the mask but rests against the rear side of it.

Published data on the 17HP4-B indicates that the overall size of the envelope is 15-25/64 x 12-9/32, each dimension plus or minus 1/8 inch. The active screen limits, which would approximate the finished size of the mask opening, are 14-1/4 x 10-3/4 ins, both representing minimum dimensions.

Because the tube face is markedly convex, it will not rest flat against the mask plate. To build up the rear of the mask plate you will need some scraps of soft wood, such as redwood or Baltic pine, no less than 1 inch thick.

Cut these scraps so that they form a complete ring around the cutout. Roughen the underside and the rear surface of the ply, coat with good glue and place the scraps in position. Weight down and leave overnight to dry. Don't pin the pieces in position, because they have to be contoured later, and metal pins would greatly complicate the task.

When the glue is set, get to work with spokeshave, rasp and sandpaper, cutting away the surplus wood until the tube face fits snugly into position. Make sure, however, that the tube does not come forward sufficiently to protrude beyond the front surface of the mask plate.

With the rear surface properly contoured, the front can then be rounded and flared, but don't cut away the sides too much, as it will weaken the plywood mask plate.

FINISHING TOUCHES

Having worked the mask into an acceptable shape, it can be sanded down and a strip of felt glued to the rear surface, against which the tube face will ultimately rest.

Three chocks have to be attached to the back of the mask plate, one to either side of the bulb and one underneath, to hold it centrally in position. The chocks can be about three inches wide, protrude

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abou the same amount and be con-oure to match the bulb Cut them rom a scrap of strong, close-grained oo. and glue and screw them firmly p ce.

To hold the tube forward against the mask plate and also to support the yoke. fe metal components will have to f ricated. They can be made most sil by the home handyman from brass.

Be n by making up the two "V" straps shown in the diagram. A -inch brass whitworth bolt should p sed through the apex of each, lock i place with a nut and sweated for strength

RH CONNECTION

Th "V" strap assembly provides a d means of earthing the outer coat- the picture tube envelope. Rivet on a 3-inch leaf of spring brass to the V-straps (located on the side pote to where the EHT connection e), and bend so that it will bear t the tube envelope.

ater, by slipping a wire from th cable to the picture tube base uerneath one of the holding nuts, th whole assembly plus the picture tu envelope can be earthed to the chssis.

T feet have to be bent over and ll so that they can be anchored to 3/16-inch bolts set in the mask Countersink the heads below the fle and lock the bolts in position hnuts, using a second nut and washer cure the straps. Hide the bolt with plastic wood, along with the es holding the chocks mentioned and sand smooth

Ler, when everything has shown to properly, the face of the mask can be ind, sanded and finished with a suit- le flat finish paint Light colours rang rom a powder blue to a buff or or are a good choice, the last-named ir a match for commercial ivory nol knobs

Aoid dark colours, which tend to mish the apparent size of a 17-inch ren

I surround the narrow portion of e ulb, you will need the ring assembly urated. This can be fabricated easily ogh, using ordinary bench tools and pimber's soldering iron.

HOW TO MAKE

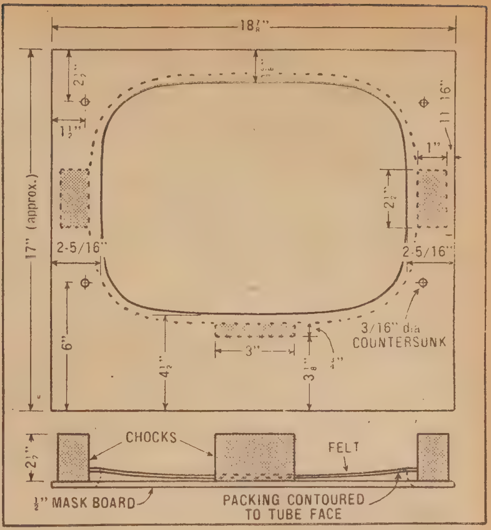
Ct the requisite strip of brass first, en into a circle, lap the ends and ecie with a couple of flush rivets.

Next step is to attach the two angled ackets which receive the bolts at the pe of the V straps mentioned earlier. The can be made up from the same arial as the ring.

Sggested procedure is to shape the ea section of each bracket first and ttach to the ring by a single rivet. The o sections can then be formed and ved in position, the sections being el together right at the tip by a further nal rivet.

This done, the whole assembly can e warmed over a gas ring and all is securely sweated, with the aid f large soldering iron.

ou will need a few inches of sponge ber to act as a cushion between the dg of the tube locking ring and the a envelope. We used a length of n 1in rubber, obtained from an auto ply house. It was partially split along length and slipped over the forward dg of the ring.



This diagram shows the position of the tube face cut-out in the mask plate. The exact shape is best derived from manufacturers' tube dimension diagram or from the picture tube itself. If a commercial mask is used or the tube mounted on the chassis the screen would need to occupy the same position relative to the cabinet front

The two remaining small brackets are best made from 1-8in brass strip, heated and bent to a right angle. Pass 3in x ¼in Whitworth brass bolts through the short side and sweat in to position. Drill a couple of holes in the longer side and tap 1-8in Whitworth so that the brackets can be attached to the ring.

The final item is a simple flat disc of thick bakelite, plywood or perspex, shaped as shown. It slips over the two bolts just mentioned and locks the yoke against the picture tube neck

The accompanying photographs show the complete tube and mask assembly as it fits together inside the cabinet.

To assemble ready for operation, clean the safety glass thoroughly and push it into place, followed by the mask plate carrying the V brackets

Screw the expanded aluminium into place over the dummy speaker hole, followed by the aluminium and speaker on the opposite side Then push the picture tube up and into place, slipping the ring assembly over the neck and over the bolts terminating the V straps. Lock into position with wing nuts tightened firmly but not excessively

> Complete metalwork for the R & H television receiver is readily available through trade supply houses, including chassis, EHT cage sub-chassis and brackets. For those who want to make their own, blueprints can be supplied from our office for 12/6 post free.

The tube should be mounted, by the way, with the E.H.T connection on the right, as you look into the rear of the cabinet.

The yoke goes into position next, with the leads coming out the underside. The bakelite plate goes behind this and is held in position with a further two wing nuts.

Two other ite have to be added before the picture tube can be operated The first is the centering magnet which slips on to the neck of the tube, narrow end first. Set the two levers close together to begin with and push it forward to about ¼in behind the yoke retaining plate.

The second item is the ion trap magnet, which is quite critical in its placement.

Slip it over the tube neck from the side so that the tiny magnet block is about in line with pin 12 on the base, with the red spot downward, adjacent to pins 9 and 10. It should be about ¼in to ⅜in from the bakelite base.

At this stage, the picture circuits are ready for their initial test. It is assumed that the receiver has already been in partial operation, receiving sound from the stations If you have been able to check the operation of the synch. separator and the two oscillators with the aid of a CRO—even an audio type CRO —so much the better

You may or may not have had the deflection output amplifiers in operation. As mentioned last month, these should not be operated unless the yoke is connected to form a load, though it does not necessarily have to be in position around the neck of the picture tube

SET CONTROLS

If the line and frame circuits have not already been synchronised by means of a CRO, set the Frame Hold potentiometer at half rotation and turn the Contrast and Brightness full off.

Screw the Line Hold control in till the adjusting screw protrudes about one half-inch from the base of the coil. Set the core of the Sine Wave oscillator coil about half-in, half-out of the winding.

Set the Horizontal Drive capacitor at about half adjustment, likewise the Height, Width and Linearity controls. They will not remain at these settings for long, but it is more sensible to start from a centre setting than from either extreme.

The first job is to check on the presence of EHT for the picture tube. Connect the deflection yoke to the receiver, connect the earth wire from chassis to the picture tube coating and framework, but do not plug in the picture tube socket nor the EHT lead.

With an EHT voltmeter available, it would simply be a matter of measurement, but, in the absence of such an instrument, much cruder methods must be adopted. Let the lead dangle freely about an inch above the table top, with the metal connector exposed

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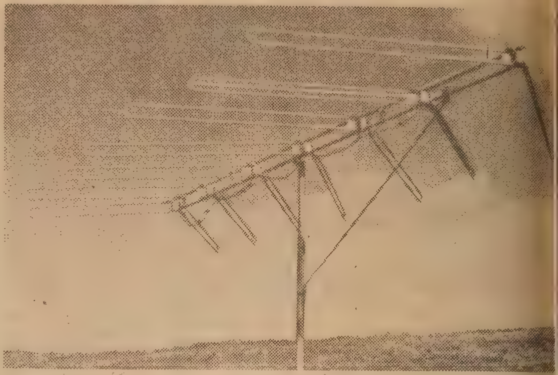

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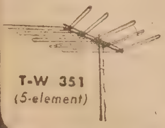

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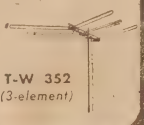

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witch on and, about the time sound iss s from the loudspeaker, you will pr ably hear and see a corona disch ge from the connector. If not, ca one end of a multimeter lead and bri the prod gradually towards the me l tip. A single discharge or spark wi be enough to indicate that the EHT cir it is working in a fashion. Don't pla with it after that.

witch the set off and use the same ea ed multimeter lead to remove any ch ge from the circuit. Do likewise o he picture tube EHT nipple and ect the two together.

It is a good thing, by the way, to evelop the habit early of discharg g the EHT circuit before hand g the wiring or the picture tube. he charge can linger for at least a ll day and, while not directly dan rous, could conceivably cause one mishandle a tube, with disastrous sults.

ow plug the picture tube socket on o he base, prop up a mirror so you the tube face and switch out all ecessary room lights. Check to see the Brightness pot is set for MINI- M brightness and switch the set on.

MAGE TO TUBE?

he point behind this precaution is wfold. In the first place, no pattern till may appear on the screen unless h ion trap magnet is close enough to mum setting to direct the electron am through the gun structure.

econdly, in an attempt to obtain a ern, the Brightness control may well advanced to the limit, causing in se local heating where the misdirected electron stream strikes some tion of the gun structure. Some nufacturers claim that permanent age can be done to the tube in this w.

y keeping the room illumination low, a first switch-on, it is possible to see th first trace of screen illumination and to move the ion trap magnet in the rit direction for increased brightness.

t is not possible to predict a position f the Brightness control where a pat t should become visible because. a rt from normal variation in com pnent values, the beam current cut- o bias can vary widely with individual tes of the same type.

The only direction one can give is to advance the Brightness control gradu a until some illumination appears on t screen. If nothing is evident by the te a mid-setting has been reached, lve the control in this position and t a small movement of the ion trap gnet, moving it slightly fore and aft ad slightly around the neck.

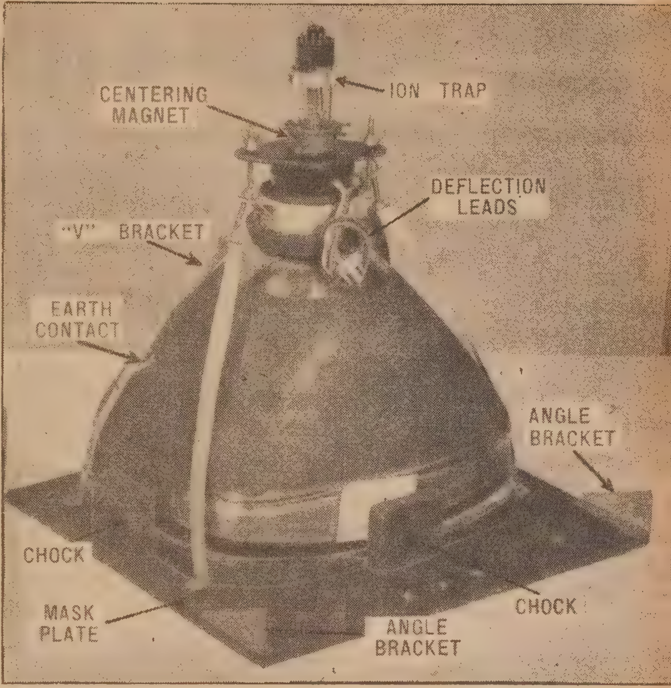
RIGHTEST TRACE

If still no trace appears on the screen, vance the Brightness control and try ain. The magnet should be set initi y at the position which gives the ightest trace.

Normally, this should be some kind a pattern spread over the whole een. A bright line across the centre the screen only would indicate that e line circuits are working and (in dentally) supplying EHT but that the ame circuit is inoperative.

In the event of this happening, reduce e brightness of the line to a workle minimum and check to see that the plus boost voltage is present. It should proximate 500 volts, as measured on ordinary multimeter. Lack of this voltage or lack of vertical deflection with this voltage available would indicate a fault, which would have to be traced out.

TUBE MOUNTED ON MASK PLATE



A photograph of the complete picture tube and mask assembly, as it goes together inside the cabinet. The mask plate wedges up behind a cleat across the roof of the cabinet, while screws through the angle brackets in the foreground secure the bottom

Assuming all is in order, however, the pattern on the screen will probably be completely random and non-synchronised. Vary the fine tuning control till the pattern is most clearly defined—a setting which will not necessarily correspond with maximum sound volume.

VERTICAL LOCK

Now rotate the Frame Hold control till the pattern appears to stabilise, at least in the vertical direction. The locking action should be quite positive, the pattern holding over several degrees of rotation.

To lock the picture horizontally, vary the core setting in the Sine Wave coil, using a non-metallic screwdriver. At one extreme core setting, the picture simply fails to lock; at the other a form of motor-boating is likely to occur in the horizontal oscillator, producing a pattern of overlapping spiky lines, with an audible squeaking effect from the deflection components.

The locking position, somewhere in between these two limits, should once again be quite positive, giving you an obvious, if not optimum, picture. Having obtained it, various other adjustments can be made which will improve its quality and presentation.

A whitish line down the centre of the picture, about a half-inch wide, indicates that the horizontal drive to the line output valve is too high. Screw in the horizontal drive capacitor in the EHT cage until the line just disappears.

If no line is apparent, screw the drive control capacitor out until the line appears, then screw it in again till it just vanishes. At this setting, with the deflection components specified, the operating conditions for the EHT rectifier should automatically be at near optimum.

Next step is to re-check the setting of the ion trap. While set nominally for maximum brightness, the trap also has a vital effect on beam focus. The ion trap should therefore be checked against various settings of the Focus control until the line structure is sharply defined.

SHARP FOCUS

Whether you prefer to view the picture this way is another matter. The important point is that the tube is capable of very sharp focus over the whole area of the screen and the initial adjustment should aim at achieving it. Focus can easily be degraded later, if desired, by rotating the Focus control. This latter, by the way, is very broad in its adjustment.

By slackening the two rear wing nuts, the deflection yoke can be rotated bodily to ensure that horizontal and vertical lines in the picture are, in fact, so.

By following the manufacturer's diagrams, the picture should be correctly

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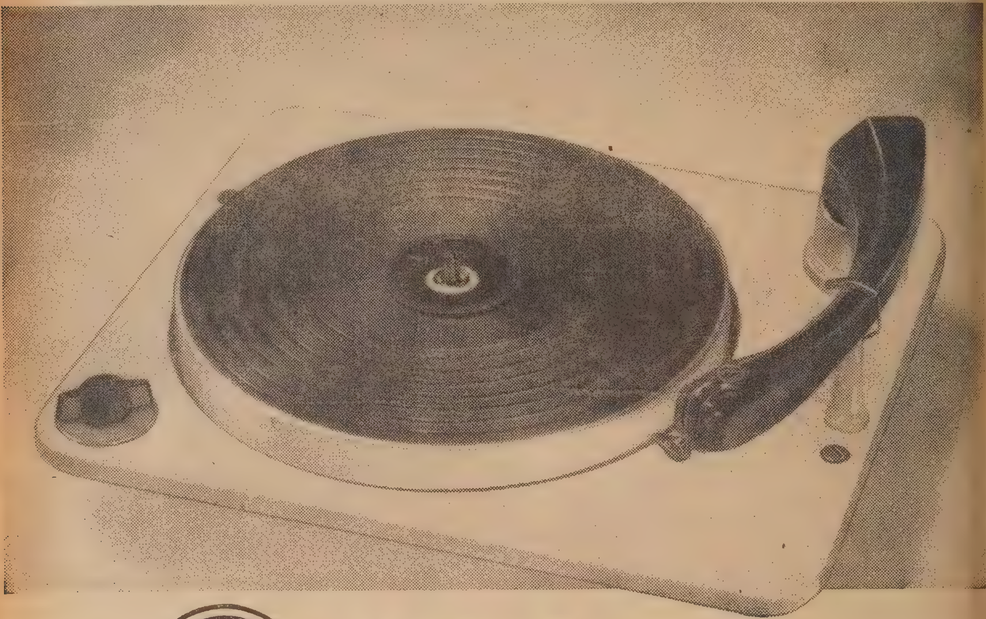

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pres ted. If, by chance, it is upside-low or transposed left-to-right, an erro is indicated in the transformer-o-y e wiring.

Don't try to correct it by swap-p over leads at random. Certain w dings within the yoke are shunt-e by damping components and the r dom reversal of leads can pro-d e a picture which might be the ri t way round but suffering from "ging" effects.

A this stage, the precise effect of the n Tuning, Contrast and Brightness n ls can be observed.

imum settings for the last two bvious enough and will vary with mbient light and viewing condit-

HTNESS CONTROL

Brightness control should be set point which gives the impression known white areas' in the picture hite, without distressing glare or . The sensation of flicker varies dly with individual viewers but ways' aggravated by having the tness control too far advanced.

Contrast control largely deter- the apparent density of the black It should be set so that obvious in the picture gives that visual ssion. Too high a setting loses the r-grey tones, clothes most char- in black and produces a black on their heads in place of a pro- high-lighted hairdo!

u will find also that the Fine Tun- control has a marked effect on quality. In one direction, the may become somewhat louder he picture tends to develop halo and to lose its darker areas. ng further in the same direction causes streaks to flash across the re in time with the sound, beyond the picture may disintegrate com- y.

ning towards the limit in the other tion will retain the picture but in a loss of fine detail. Simultane-, the sound level may diminish and ately disappear.

W TO TUNE

e optimum tuning position is ly just clear of the region where d streaks appear across the picture, hich point the sound level should ood, likewise the balance in the re between dark areas, outlines and l.

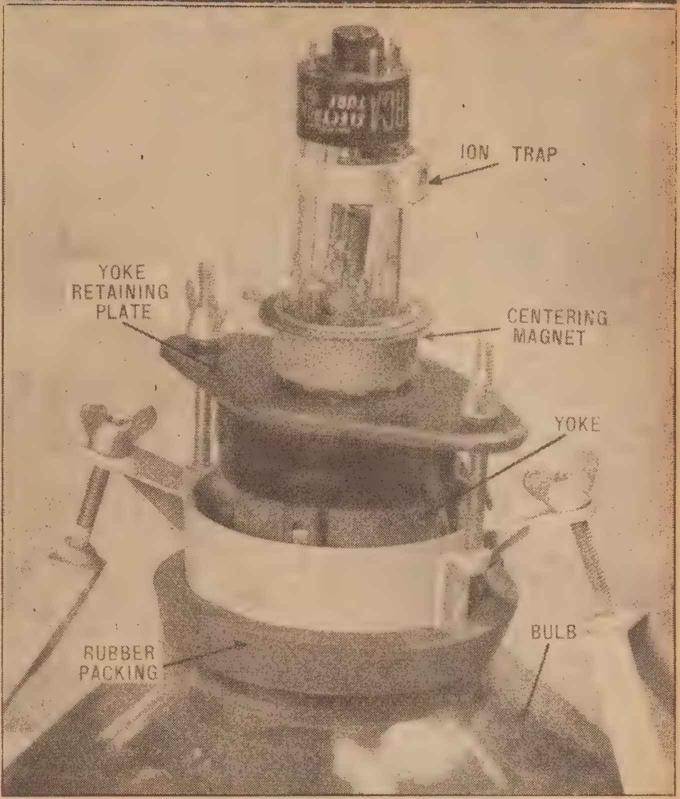
this balance cannot be achieved, n be accepted as prima facie evid- that all is not well with the overall band, or with the adjustment of ntercarrier sound channel. While may be cause for concern in itself, ed not hold up preliminary adjust- of the picture. Merely tune for est picture, irrespective of sound proceed.

ljustment of picture linearity and is best done with a test pattern the screen. These are available from local stations during the day during periods preceding normal mission.

e deflection components used in the inal receiver are expressly designed, rding to the manufacturer, to give w per cent over-scan. This is to re that, with variation in compon- line voltage, etc., the picture need r diminish below the size of the k.

rew out the width adjustment till as much of the picture content as possible is framed within the mask. If, of course, the picture can be narrowed to less than mask width, screw the adjustment in again till the picture occupies the full width of the mask opening with an additional small overlap at each end.

CLOSE-UP OF YOKE, TUBE CLAMP



A close-up view of the clamp assembly which holds the tube in position and which also clamps the yoke aganst the bulb flare. A spade clip at the end of an earth lead from the chassis can slip under one of the wing nuts, earthing the assembly and the outer tube coating.

VERTICAL ADJUSTMENTS

Now turn attention to the Vertical Linearity and Height controls. As we mentioned earlier, these are interdependent in their function and must be adjusted for best mutual effect.

You will find that the Linearity control tends to compress the top of the picture and open out the bottom as the amount of resistance in circuit is reduced. The Height control tends to open out the top of the picture more than the bottom, as the tapping is rotated toward the cathode end.

In practice, the best procedure is to set the Linearity control at about centre rotation and adjust the Height till the picture fills the screen, again with a small overlap. Observe the line structure and note whether the lines are more open in one region than another. Now rotate the Linearity control by a few degrees, re-set the height and re-check the line structure. If the linearity has improved, turned the Linearity control a few degrees further, readjust the height and check again. If the linearity has worsened, reverse the direction of adjustment.

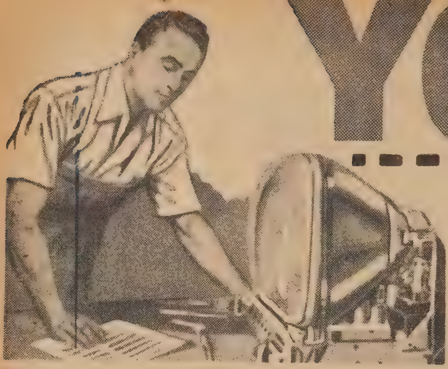
During the process you may become aware that the picture is off-centre on the screen and this calls for an adjustment of the centering magnet.

It is difficult to give precise directions about the way to do this, except to say that the magnet unit has the weakest total field when the levers are together, the strongest when they are diagonally opposite, with varying patterns when occupying intermediate positions.

TRIAL AND ERROR

The idea is simply to rotate the centering unit in its allotted position on the neck and with the levers in various relative positions. It should be possible to find a setting which centres the picture almost exactly on the screen.

After the initial run through, all these picture adjustments are best rechecked with a circle test pattern on the screen. It should be possible to get something very close to a true circle but beware



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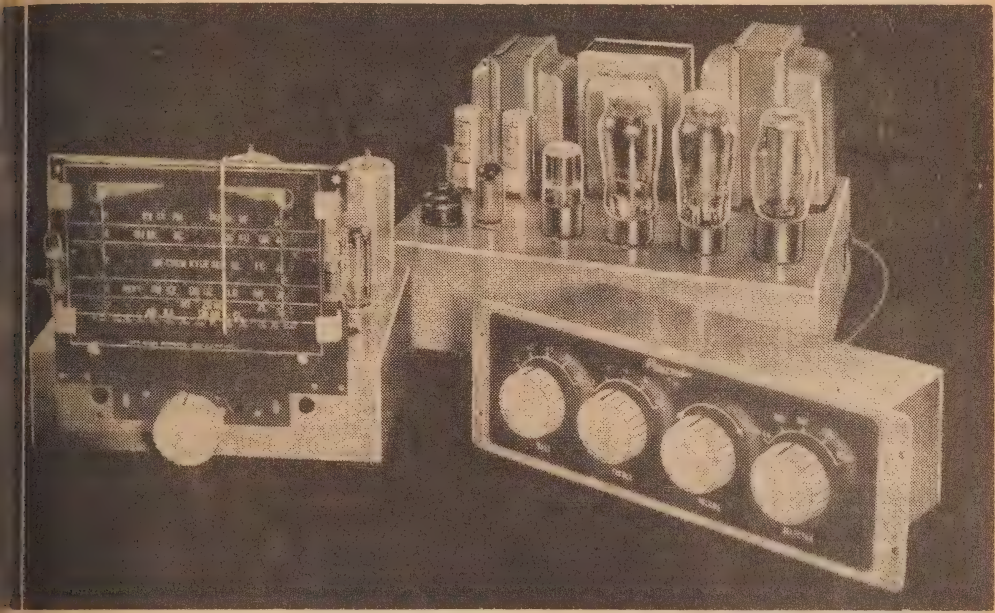

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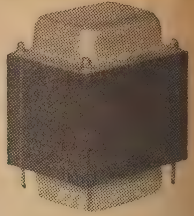

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of adjustments which produce good linearity at the centre but which cause the top or bottom of the picture to op out sharply.

compromise has to be made, which should be slight only, it is preferable to have a small non-linearity at the centre, which will not be noticed in an ordinary picture, than to have sudden elongation of heads and feet as figures move about the screen. This elongation effect can be most disconcerting.

he horizontal linearity in the original receiver was never a problem but the effect of the adjustment can be observed during these tests.

At this stage, it may be worthwhile to re-examine the setting of the Line Hold and Sine Wave coils.

f the core in the Sine Wave coil is screwed slowly in one direction from its normal "hold" position, an obscure "ringing" effect is noticeable, vertical lines becoming wavy.

ADJUSTMENT

Screwing the core away from this position gradually straightens the lines, then the whole picture is gradually curved sideways, with all vertical lines strictly straight. Further adjustment of the core in the same direction suddenly produces loss of synchronisation.

f the core is set too close to one extreme, vertical lines may show some curvature, though the picture will synchronise very easily. With setting towards the other extreme the oscillator may not synchronise immediately, when switched to a new Channel.

It is worthwhile to experiment with alternative settings of the Line Hold control and Sine Wave core, to determine those which ensure immediate synchronisation without distortion of vertical lines.

For the sage of reference. the Hold controls never need touching in the original receiver and synchronisation is immediate, no matter how quickly the Channel selector is operated.

With the picture properly adjusted, the accuracy of the line interlace can be observed. You can do this by "playing tricks" with your eyes.

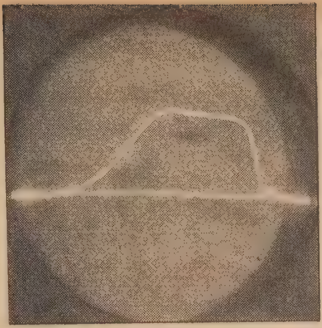
CHECKING INTERLACE

Look at the top of the screen carefully from about 15 inches away, then deliberately and slowly shift your gaze downwards, looking at the line structure as you do so. Your eye will suddenly seem to see the whole line structure gradually moving down the screen.

The same strobing effect can be obtained by moving the eyes upward from the bottom.

Then, by staring fixedly at a particular point in the picture and not allowing the eyes to wander, it should be possible to observe how the two sets of lines combine to cover the picture area.

With sharp focus and perfect interlace, only a faint darker streak should be visible between adjacent scanning lines. In practice, perfect interlace is difficult to obtain and the spacing between adjacent lines may not be exactly equal, though both should be discernable.



Here is an unretouched photograph of the IF pass band characteristic of the original receiver. The 36Mc point is just perceptibly above halfway on the left-hand slope, while 31.5Mc is about 25% down on the right-hand side.

If the scanning lines are boldly apparent, with black spaces between them equal to the line width, and if the strobing effect previously mentioned cannot be observed, it can be assumed that the interlace is not operating at all and that the two sets of lines are pairing.

There is no basic reason why this should happen in the RT&H receiver, as far as circuit design is concerned. The one thing which will cause it above all others is a leakage of energy from the line deflection circuitry to the frame oscillator valve.

We have already stressed the importance of preventing this beneath the chassis, by suitable orientation of wiring and by the use of the small shield plate specified.

DEFLECTION LEADS

Above the chassis, trouble can follow if the deflection leads to the yoke are allowed to dangle near the frame oscillator valve. This can easily happen unnoticed, particularly when the chassis is finally installed in the cabinet. Keep the leads up out of the way.

Though not directly specified, the original chassis did have a shielded valve base around the vertical oscillator and the use of a can over this valve is a simple precautionary measure.

The remaining item which calls for special comment is the sound trap in the cathode circuit of the video amplifier. We must confess to another slight error in the circuit which was not specifically mentioned last month. The tuning capacitor across this trap should be .0022 mfd. as shown in the parts list, not .003 mfd as in the circuit.

THE CIRCUIT

READERS are reminded that the circuit of this receiver appeared in the May issue and that certain minor corrections were listed in the June issue on page 64. Note that the sound trap tuning capacitor should be .0022mfd. not .003 as shown.

The 3,900-ohm 4-watt resistor shown in the parts list should read 3,300 ohms. For the Contrast control, use a full size 500-ohm carbon potentiometer. Cathode of the 6BQ6/6CU6 connects to pin 8.

The easy way to adjust the trap is to feed a 5.5Mc signal through a capacitor to the grid of the video amplifier, observing the output at the plate on a VTVM probe or wide-range CRO. Simply adjust the trap for minimum output as the trap passes through resonance.

In the absence of suitable test equipment, the trap can only be adjusted by observing its effect on the 5.5Mc component in the picture. If such a component is present, it will cause a very fine pattern along each line, not much longer in detail than the line is wide. Adjust the trap until the pattern is least apparent.

Fitting the receiver in the cabinet calls for no special comment, most of the detail having been covered earlier in the article. The control knobs, however, require some explanation.

Both the Fine Tuning and the Brightness control have shafts larger than the normal quarter-inch diameter. In the original receiver, the Fine Tuning shaft is 5/16-inch and the Brightness shaft a trifle less.

CONTROL KNOBS

Standard 1 5/8-inch radio knobs can be opened out to the necessary dimensions with a blunt drill or a suitable file. Make them a tight push fit, so that reliance does not have to be placed on the grub screws.

This done, file the front of the knobs flat for a diameter of about ¾-inch.

Standard 1¼-inch knobs of the same type will serve as the band selector and volume controls, the latter bushed down to shaft size with a scrap of ¼-inch tube, split along its length.

One-inch knobs serve for the three minor controls in the centre positions.

The subject of television aerials, feeders, etc. has been covered in earlier in earlier issues (November, December, 1956) and does not call for further lengthy comment.

In average areas a fan-type aerial or equivalent should provide the right order of signal for the receiver in its present form, being well within the capacity of the simple A.G.C. system.

SIGNAL OVERLOAD

Close to the transmitters, the signal level from a large aerial may be excessive, especially on Channel 1. Excessive signal can cause excessive contrast, "negative"-picture effects and haloes. In extreme cases, clipping of the synch. pulses in the IF channel can produce loss of synchronisation or tearing of the picture.

These remarks apply, of course, to any receiver using a simple A.G.C. system and indicate the desirability of using a more modest aerial in such a case.

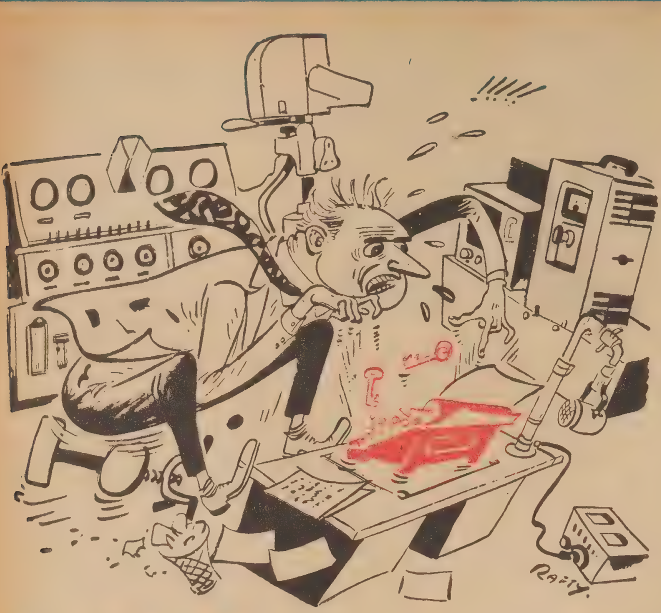
Increased tolerance to high level signals can be achieved very simply in the RT&H circuit by eliminating the delay and clamp circuit from the tuner A.G.C. line, allowing the full A.G.C. voltage to be applied to the tuner at all times.

In the remaining space available, it is not possible to say very much about the i-allmportant matter of IF channel alignment. This whole subject will need to be covered in a future general article.

At the outset, we assumed that readers would purchase a completely aligned pre-fabricated IF strip and many, in fact, are doing this. Plenty of others, however, are buying the components and wiring their own.

Some are using "Q-Plus" components as in the original set and, provided the

(Continued on Page 121)



Let's Buy An Argument

My reference, last month, to an "old-timer" was apparently a bit "close to the bone" for a reader in Sutherland, NSW. He reminds me of a fact which is only too evident, I'm afraid, to my barber, my dentist and my children. I—we—are all getting older.

by Neville Williams

OUR friend from Sutherland writes as follows, and I quote:

"Dear Sir,

"I notice your reference in the current issue to 'old-timers'. I hope it wasn't in ridicule, because the time mightn't be far distant when a new generation will refer to you in the same terms.

"Anyhow, I'm one of the 'old-timers' as you call them and I want to ask an old-timer's question. Why have they dropped grid caps again? I'm not disagreeing with the move, mind you, but it isn't so many years ago since we were fed with articles about why they were necessary. Something doesn't add up.

(W.P., Sutherland, NSW)."

First, let me assure W.P. that there was no thought of ridicule in using the term in question. Just the reverse, in fact.

If we really want to be rude to somebody in these columns, we usually manage to make it plainly obvious.

However, W.P.'s question is a good one and the position may look rather confusing from where he stands.

Back around 1930 and beyond, valve electrodes were all brought out to base pins, which were easy to remember and easy to wire.

Then, all of a sudden, top cap connections appeared and they were a confounded nuisance. They called for trailing leads out the top of coil cans and IF transformers. They called for clips, which either fell off the top-cap, or else stuck so hard that you pulled the cap adrift from the glass, trying to separate them.

SHORT TO CAN

Alternatively, they would short intermittently to the top of the valve can, particularly with valves which happened to be a bit longer than average.

For the unsuspecting, there were caps which connected to plate instead of to grid and which therefore carried e full high tension voltage. A lov handful, indeed.

Then, just when we'd all got u to these things and accepted the ar ments as to why they were necessa along came new valves without p caps. Better valves, mind you.

Why couldn't they have done this the first place and saved a whole of worry and service calls?

I must admit that, on the surface, t looks anything but consistent, but, ac ally, there's a very simple and pra tical story behind it. It's quite certa that valve manufacturers didn't put ca on the top because they enjoyed doi so. Arguments over loose top-caps a over-long valve envelopes weren't go for business. They just didn't know better answer at the time.

THE VALVE STORY

The story has been told in oth places at other times but, since t question has been raised again, it w probably bear repeating in outline, least.

As was only to be expected, ear valve manufacturing techniques we borrowed freely from the lamp ma ing industry and the most notable her tage was the "pinch" type of constru tion. It is illustrated on the left in th accompanying diagram

Connecting leads were brought u through a skirted tube, whose top wa heated and compressed to hold ther firmly in place. The leads were the trimmed and bent on a jig to suit th particular valve.

The pinch also carried an exhaust tub to permit ultimate evacuation of the gla bulb.

Operators then welded grids and pla to the support wires until the complet electrode structure was built up. Th done, the pinch assembly was put int an automatic machine, which sealed glass envelope over the top, complete ly enclosing it.

Next stage in the manufacture, als carried out on automatic machines, in volved extracting the air from the bul and firing the "getter". Then the bas was added, the cathode heated and age and the characteristics checked.

This general technique, with variation was used almost universally for man years. It suffered a major disadvantag however, in that leads from the actua electrode structure, down through th pinch to the base pins were inevitabl two inches or more in length. They therefore, had a definite and inescapabl capacitance one to the other.

This didn't matter much with ordinary odes or audio amplifiers, but it did tter when RF tetrodes and pentodes re introduced to overcome the probns of grid-plate feedback.

It was plainly futile to introduce a een into the electrode structure to nimise grid-plate capacitance there, do nothing to reduce capacitance beeen relevant leads inside the pinch e and socket.

Since there was no easy way of short ng the leads, or of moving them furr apart or shielding them one from other, the only resource was to bring ner plate or grid out the top of the velope. Hence the practice of doing

DUCTANCE PROBLEM

Valves might still have been made t way, had it not been for the fact t increasing use of the higher freency bands also made it essential to uce the length—and therefore the inctance—of all internal leads. New nufacturing techniques simply had to found.

One of the most significant advances s the development of metal valves, illustrated. In these, the pinch type construction was abandoned and elecde support wires passed straight up m the base pins, through glass beads the bottom of the envelope.

This construction greatly reduced the gth and inductance of the leads and o made it possible to reduce the eftive capacitance between any two of m by placing them on opposite sides the base, with the metal exhaust tip other "earthy" electrode pins beeen them.

By careful planning and placement it, refore, became possible to make sucsful "single-ended" RF pentodes.

Though metal valves were not a comrcial success for other reasons, the lesis learned in their development were t lost. Having broken away from the ditional "pinch" techniques, manufacers applied them to the development modern all-glass miniatures.

The construction of a modern miniae is illustrated at the right and the ference from the old pinch-type consuction is immediately apparent. ere is no separate base and no bulky e pins—just wires which come saight up through the bottom of the ss envelope.

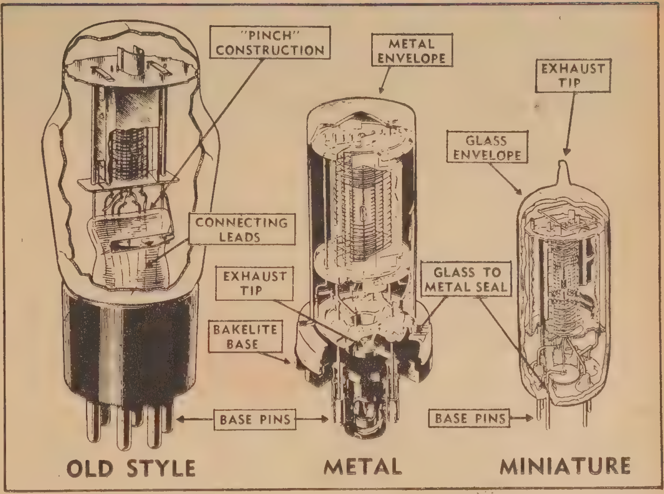
RVE AS PINS

At one end they act as pins. At the er, they are bent over and provide port for the electrode structure. Inentally support points around the cirnference of a circle make for a much re rigid assembly than support wires a straight line.

The important point is, however, that leads are comparatively short, mak for low inductance. And because y are short and well spaced, it is posle to interpose shield vanes and other "rthy" leads between grid and plate, is keeping the effective capacitance to mall figure.

In the socket, too, an earthed-metal tre spigot shields grid from plate, and is incumbent on the set builder to ep the relevant leads well apart. For to earth the spigot and a high freency amplifier stage will oscillate like champion.

WHY NO TOP-CAPS ON VALVES?



A reader from Sutherland, NSW, thinks he can see an inconsistency in valve makers' ideas during the past twenty years. Valves were originally single-ended, then they sprouted top-caps for a while. Now they are back to single-ended.

But I think the point should be clear, W.P. The single-ended construction is now only possible because of a completely new approach to assembly, sealing and basing.

Why didn't they do it back in nineteen-thirty something? Simply because thinking and techniques hadn't advanced that far.

Put yourself in the position of a factory chief who has a building full of expensive automatic machinery based on the bulb, pinch and bakelite base techniques. He can produce an RF pentode by the expedient of providing a metal top cap.

THE "UNKNOWN"

The alternative is some as yet untried technique of sealing metal pins into a glass button base, building an electrode structure on to it, then welding it to a glass bulb, without the whole thing dissolving into a molten mass in the process.

Even assuming it to be practical, he has no machines to cope with such a technique on a mass-production basis. To develop and build them would cost a fortune, not to mention the many other machines necessary to produce the special "bits" which would be needed for the new valves.

What would you do?

Of course you would.

And that's the way it is with so many new things. They're not suddenly invented, but grow out of techniques developed over many years.

To change the subject, our worthy friend "The Serviceman" dumped a letter on my table the other day,, which had originally been addressed to him via this office.

"You buy all the arguments around the place," quoth he. "Have a go at that one."

"That one" was a letter from R.F.C., in Launceston, taking the serviceman to task for one of his statements. The letter is reproduced in precis form over the page.

As you can see, our friend can't understand the statement that the mere substitution of a better speaker can make any worthwhile difference to the reproduction from a mantel set. His idea is that you should start at the other end, building a good amplifier first and making do with the best speaker you can afford.

Well, I can't entirely condemn either R.F.C. or the serviceman's friend for their points of view, for they are both half right.

It's rather akin to an argument which I heard recently in other circles about what one should look for in buying a second-hand car. One maintained that a good engine and gearbox was fundamental, the bodywork being a secondary matter. The other party maintained that bodywork and upholstery could never be restored, once ruined, but an engine and gearbox could.

POINT OF VIEW

The only thing obvious from such an argument was that both were willing to compromise and that both of them would be better off than a man who bought a car having a bad engine and bad bodywork as well.

In just the same way, the quest for good sound demands attention to both the amplifier and the ancillary equipment. To provide either one without the other is to do only half the job.

But that doesn't say that an improvement anywhere in the system won't be noticeable or worthwhile. If any proof of that is required, I need only refer to our current television receiver.

There's nothing pretentious about the audio amplifier or the speaker either, but I've lost count of the number of people who have commented on the sound quality.

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ARGUMENT FOR "THE SERVICEMAN"

Dear Mr. Serviceman,

I am a constant reader of your articles, which I usually find most interesting. But I am afraid I spotted something in this month's issue which brought me out of my complacency. It was the bit describing how a colleague had hum trouble caused through coupling with an electric clock.

Well that part of it I found most interesting but how on earth does he prove that a good quality speaker will make most of the difference to producing good quality sound?

Did he imagine a great deal? Was it because his original speaker was small or old? Was it because it was mounted in a bakelite cabinet, which is poor at any time?

My argument is that it is not possible to get near to perfect sound reproduction from an expensive speaker using only a mediocre single-ended amplifier. Obviously, the best speaker in the world can't get rid of distortion which such an amplifier introduces.

To bear up my argument, I have just completed the amplifier using two 6BM8's as described in a recent issue of R, T & H. Using only a cheap output transformer and a modest Rola 8-0 speaker, the difference compared with our commercial radiogram is the difference between night and day.

(R.F.C., Launceston, Tas.)

THOSE COIL SLUGS

Dear Sir.

I read recently your "beef" on the subject of pesky coil adjusting slugs and I'd like, if I may, to offer my "solution" to the problem. Compared with your suggestion of the hexagonal rods, which gets right to the root of the problem, mine is only a treatment of the abovementioned type of slug.

To get down to it, I seal the slugs with beeswax which, I think you'll agree, is quite easily come by. Beeswax has a fairly high melting point (64 degrees C.) but I think more important is its tenacity combined with a certain amount of plasticity at normal temperatures.

I've found that it holds slugs quite firmly but still allows you to carry out further adjustments without having to melt it away. Adjustments done, a touch with the soldering iron remelts the wax, which is then allowed to cool in its own time.

If you happen to put too much on at first and cover the whole slug, a sharp knife will pare away the excess.

(E.B., Mt. Waverley, Vic.)

---

y?

ll, apparently because the 8in er in a wooden cabinet is a cut the usual mantel set. In addi- it has a small amount of built-in oost and the advantage of a clean ignal input.

just the same way, RFC's amplifier ndoubtedly deliver a more liberal better-balanced signal than the ercial radiogram, with the inevi- result that it sounds better.

don't lose sight, either, of what erviceman's friend accomplished by a large, well-baffled speaker with d quality output transformer.

would have recovered a whole of bass response and some of eble, which must have been miss- rom the small output transformer ormer small speaker.

E IMPROVEMENT

must have reduced the total dis- n by whatever margin of merit the speaker had over the small one. ermore, because the larger speaker almost certainly have been more ive, he would obtain the required t with the amplifier operating at level and probably lower distor-

all that didn't add up to a notice- improvement, I'd be very surpris- I agree, however, that he might realised nearly as much improve- at considerably less cost by using ge speaker of more modest design, rly fed and baffled.

om past experience in these mat- I'd say that the greatest danger in g a high quality speaker to a poor ver or amplifier is that it will make le gross distortion which might be nt.

ings like inadequate AVC, a badly ned detector circuit, or a faulty ling capacitor can cause distortion can be most distressing through de-range speaker system. But then sume that our serviceman's friend d have made sure that the set was ing properly before he went to the le of adding the transformer and er.

RE TROUBLES

y remarks recently about troubles iron cores were apparently read approved.

ere was also a certain sympathetic ort for my grouch about the les caused by the iron-core adjust- s in coils and IF transformers.

is quite obvious that many readers suffered precisely the same annoy- s as those listed. Nor has the pro- finished. The spate of activity ght on by television set building meant that more people are dis- ring for themselves the nasty little s of iron cores.

a typical strip with 16 cores, 15 em might work like a charm. It's inevitable odd one that causes all other. It jams, or breaks, or slops t in the most exasperating fashion.

reader from Mount Waverley, offers his own "solution" to the lem. The pun is his, not mine. It the use of beeswax.

ite frankly, I frowned somewhat is opening sentence, much as W.P. must have done at my use of "old-timer."

Then I realised that the word "beef" had a purely accidental connection with another Australian colloquialism, which isn't quite so complimentary.

As to whether beeswax is better than any other wax for sealing cores, I'm not sure. E.B. thinks it is. You may think otherwise.

I'm not even sure about its being readily available. It may be in Mount Waverley and it certainly was on the mixed farm where I spent some of my youth. But in the wilderness of George St. or Collins St. it may be a completely unknown commodity.

One day last week, for example, I was fiddling with the IF channel in a receiver, the brand of which had best remain unmentioned. All went well till I went to touch up the slug in the ratio detector transformer, the very last in the line and the most important.

It moved a couple of turns, then stuck fast.

VARIOUS METHODS

I coaxed it, talked nicely to it, tapped it, tried a little gentle persuasion, then a modest show of force, all to no avail. I removed the bottom slug and tried a tool top and bottom but, no, it refused to budge.

By that time, the cardboard former had loosened from the end mouldings and one of the internal wires had broken. The transformer had to come right out, the core had to be cracked and chipped away, the winding repaired and then the whole thing soldered back again.

That kind of thing is enough to try the patience of anybody, especially a serviceman, whose livelihood and good name is ticking away while he fiddles! Of course he can get a new transformer but, unless he has a wife and family who love making special trips into the city, the customer has to wait around until the replacement permeates through the postal system.

It just shouldn't happen!

ONLY REAL DANGER?

Personally, and with all due modesty, I feel that the only proper answer to the problem is the one I suggested some months ago — a little plastic thing like a flat-headed nail but with a hexagonal shank to fit through the cores.

After alignment, you would push it down through the cores, seal it to the top of the can and forget your troubles.

In most cases, the cores could be "wangled" enough to let the shank pass straight through, without upsetting the effective alignment. If not, the shank could be clipped off and two of them used, one from the bottom and one from the top.

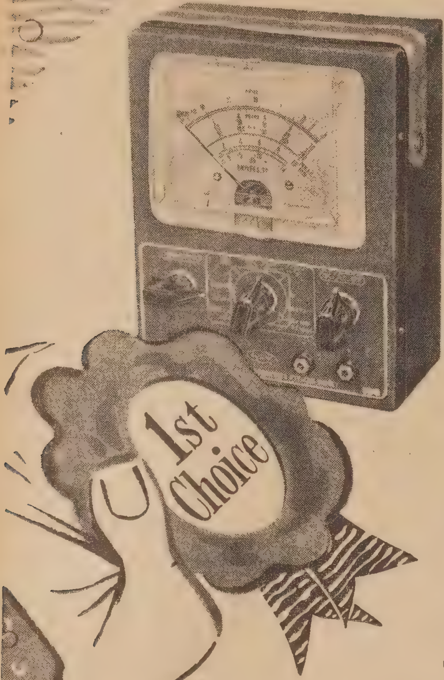
One reader, commenting on the idea, suggested alternatively that the head of the thing could be moulded flat, in line with the shank but split so that it could be pushed down and sprung into the actual former.

I think that something like this will be inevitable but it just awaits somebody with sufficient time and energy to organise the die for the job.

In the meantime, here's another thought that might lead somewhere. This one was born, in a sense, of necessity.

I was fiddling around at home with a device which was suffering from the malady known as "sloppycoritis" and

(Continued on Page 121)



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D AMPLIFIERS SOUND DIFFERENT?

cently the opinion that the loudspeaker is the weakest link in the reproducing system and at amplifiers have progressed about as far toward perfection as it is possible to go has en widely expressed. As a basis for this conclusion, it is stated that the residual degree various kinds of distortion present in modern amplifiers is so small as to be impossible to hear. However, many are not yet satisfied that this philosophy is true.

By NORMAN CROWHURST

illustrate this view, the following xperience is by no means impos- or uncommon: two different ampli- re compared, using the same pick- tuner as a program source and ame loudspeaker. Both amplifiers, gh of different design, use the input and output impedances, pro- he same damping factor for the eaker, and give frequency respon- nd degrees of distortion which e by an acknowledged imper- le amount — yet any discrimin- listener can discern quite an ap- ble difference between the sound ogram played through the two iers.

ERENCE IN SOUND

example, a trumpet recording is through the two amplifiers and e sounds quite clean while on the there is a definite harshness about production. When the gain control ned back the harshness becomes noticeable, but only because the is that much lower — it does not ear completely, as one would if it were due to clipping, or an ad effect.

became quite evident that some- happens inside some amplifiers that adequately covered by the speci- ns. Incidentally, the amplifiers checked on the same measuring nent and both found to conform eir published specifications, which out the possibility that one was s good as it claimed.

ne work the author has been doing ly has verified two possible con- ing causes for this kind of differ- From the result of these experi- it seems quite possible for an fier to perform to extremely close under standard test measurements yet, with program material, the amplifier can produce temporary ansient distortion conditions that ud enough to be perceptible. Both these transient conditions are related to the nature of the roll-off characteristic produced by the feedback.

It is well known that, when you apply more and more feedback to an amplifier, a condition is eventually reached where the amplifier becomes unstable. This is due to the fact that, at some frequency, usually below or above the audio spectrum, the feedback becomes positive and causes oscillation. The frequency of this oscillation may be down in the region of 1 or 2 cycles or up in the region of 100 or 200 kilocycles, depending principally on which happens first.

Normally, of course, amplifiers are operated with considerably less than this amount of feedback, so they do not oscillate. Naturally, one would think that a margin of 2 to 1, or a little more, in this direction would be satisfactory to insure that the amplifier could not get unstable under any conditions. Many amplifiers have been designed with about this much margin.

EMERGENCE OF PEAK

This, however, overlooks certain fundamental facts that evolve from a mathematical consideration of feedback design. As this article is not written primarily for engineers, we shall refrain from going into the mathematics of such design. It is fairly easy to understand that, as we increase feedback, before the amplifier starts to oscillate, it will show a peak in the response, in the region of the frequency where it will eventually oscillate. The question is: how much must the feedback be reduced, below the amount which causes oscillation, before the peak is completely removed?

This is where the mathematics help some: in average amplifier design, we learn that the margin between oscillation and peaking, at the low-frequency end, is in the region of 18 db; while at the high-frequency end, it will be in the region of 12 to 14 db. These figures represent ratios of 8 to 1 and 4 or 5 to 1 respectively, both of which are considerably larger than the previously suggested margin of a little more than 2 to 1. These facts are illustrated in Fig. 1.

In comparatively recent times, the importance of an adequate margin at the high-frequency end has been realised. This was shown up at first by the use of square-wave testing. If there is any peaking in the amplifier response, or if the roll-off is too sharp, this will show up on a square-wave test as ringing at the corners of the square wave, as shown in Fig. 3.

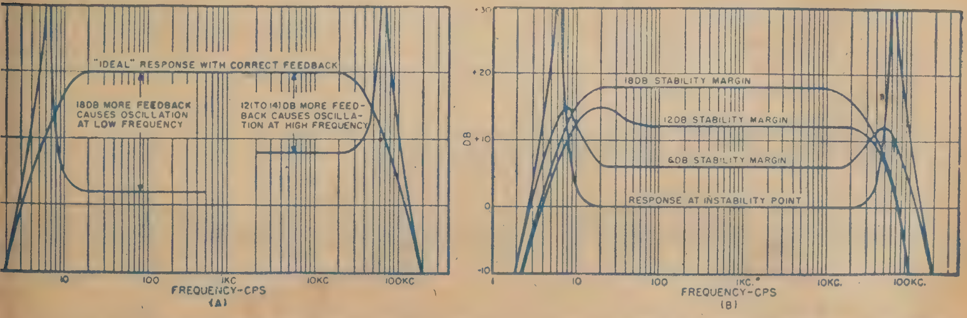
ANTI-RINGING CIRCUITS

Many amplifier designers have, accordingly, paid attention to this feature and made adjustments to the amplifier so as to prevent this ringing. This means that high-frequency peaking must be absent from the amplifier.

However, there may not be the full 12 to 14 db stability margin, because the designers have used a trick to produce a satisfactory square wave: phase-shift capacitors associated with the feedback circuit. It's true that this method produces perfect amplification of the high-frequency end, for transients as well as steady tone, when the amplifier is connected to a resistance load.

Sometimes the designer has been careful to make sure that the amplifier performs reasonably well into a reactive load, but to make this test he uses for his reactance a capacitance across the output.

What seems to have been overlooked is the fact that most people use dynamic loudspeakers (woofers, squawkers, and tweeters) whose impedance becomes that of an inductance at the high-frequency end—and an inductance that



1: (A) Ideal response when the feedback is correct; part curves show instability points as feedback is increased. (B) Effects of various stability margins on the over-all response; 12 db is proper for high end and 18 db for low end.

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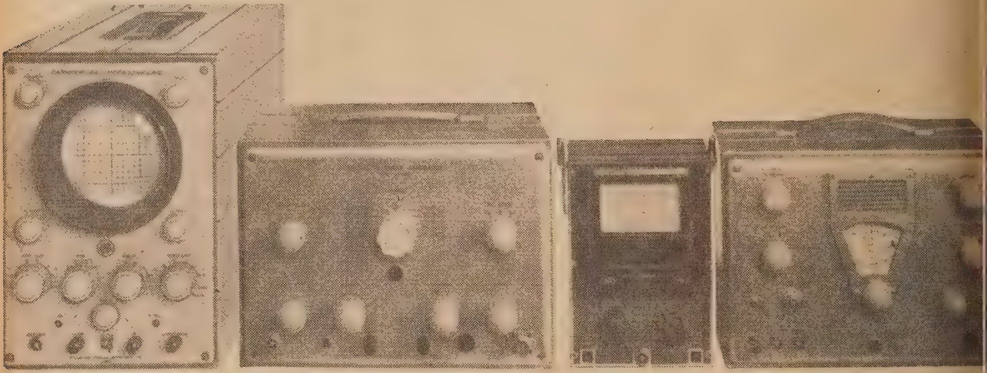

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ES1

es a reactance somewhat larger than nominal voice-coil resistance.

This means that the amplifier loading quite different from the conditions der which it is tested, as shown in g. 2.

The nature of the "finagle" used can seen by a glance at the schematic: has at least a "phase correction" pacitor across the feedback resistor, d probably has several other small- lue capacitors (values given in uufd, t ufd) at various points in the cir- it.

This produces a satisfactory response th less than the basic 12-14 db mar- n, but because of this the arrangement inevitably more critical of the correct ading on the amplifier output.

This means that the use of the in- ctive loading provided by the loud- eaker voice coil results in a transient sponse which is probably worse than would have been if the "finagle" had t been employed.

IDE RESPONSE

This fact accounts for the roughness the high frequencies, observed with number of amplifiers whose measured rformance shows no trace of over- centuation of the high frequencies, ging on square waves, or distortion this region.

Perhaps a word is not out of place re, as to why this technique is em- oyed. It arises principally from the rrent fashion for amplifiers to have a equency response as near as possible om zero to infinity.

Since zero to 20 cycles does not sound ke a very big "piece," but 20 kilo- cles to infinity sounds like an enor- ous range, the concentrated effort has en on the latter end. As a result. nplifiers have been produced with ecified frequency response extending 30, 50, 100, and even 200 kc.

While some of our high-fidelity car- onists have suggested that such am- ifiers are for the birds, this trend has nerally been taken rather more seri- usly. Because of this, amplifier de- gners have been faced with the neces- ty of meeting specifications of this nd, dictated by the promotion or pub- city departments of their companies.

OW FREQUENCY END

To get the amplifier to perform to ese specifications, they have virtually ad to resort to the kind of tricks we ave mentioned, because the only alter- ative requires an output transformer hose price would be prohibitive.

So much for the high-frequency end. he low-frequency end seems to have caped attention although, as we found, s effects can be disastrous with some nds of program material.

Most amplifiers probably have a ability margin at the low-frequency nd of at least 2 to 1, or 6 db, and obably as much as 12 db.

But, to avoid any peaking effect at a bsonic frequency, they need a margin the region of 18 db.

Unfortunately this peak does not ow up in the measured response, be- use it occurs in the loop gain char- teristic and may not show up at the nplifier output, due to the low effici- cy of the output transformer at this equency.

That is a rather technical distinction -just what does it mean to amplifier rformance? A peak in the response anywhere means that any transient condition can cause the system to ring at this frequency. If the amplifier has any kind of peak in the region of 1 or 2 cycles, a transient condition can cause the amplifier to produce a kind of low-frequency flutter of this frequency, which may take a few seconds to die away. But what kind of transient would do this?

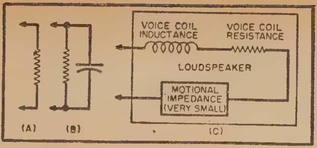


Fig. 2: (A) Common load used for testing although (B) is occasionally used. (C) Actual load offered by speaker to amplifier.

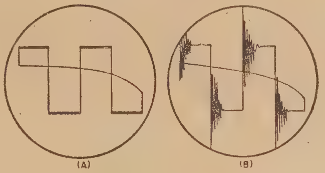


Fig. 3: (A) Good square wave applied to input and seen at output of very good amplifier. (B) A more common output waveform.

The frequency of ringing is down at one or two cycles, so the normal transient, with a sharp wavefront, will not necessarily cause this kind of ringing. The waveform that will produce it is one that possesses a momentary DC component. Many of these occur in practical program material.

ASYMMETRICAL WAVES

For example, the trumpet waveform we mentioned earlier is quite asymmetrical; this means it is equivalent to an AC waveform, with a number of component frequencies, plus a DC component which offsets the waveform on one side of zero. This probably occurs due to the fact that the instrument is blown and the air coming out constitutes a DC component.

When a stringed instrument, especially a string bass, is plucked, or a percussion instrument is played, these, too, produce a momentary deflection of the wave-form one way or the other from the zero line at the start of the tone.

Thus it can be seen that any of these kinds of program material can initiate the low-frequency ringing we have described.

In the old-fashioned kind of amplifier, without feedback, this kind of program material will produce a momentary change of bias on each stage through the amplifier. The time taken for each bias to change will depend on the time constant, as it is called, produced by the coupling capacitor and the associated circuit resistors.

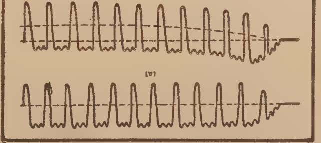


Fig. 4: (A) Asymmetric wave without isolating d.c. (B) Offsetting bias adjustment.

In other words, a continued trumpet tone will cause the bias on each stage to readjust itself by some fraction and each stage will take a moment or two to settle down to its new bias value. This is illustrated in Fig. 4.

The time taken for each stage to settle down will be dependent upon the time required for the coupling capacitor to change its charge: larger capacitors will take longer and smaller ones will allow the change to take place more quickly.

EFFECT OF FEEDBACK

In a non-feedback amplifier all these changes will take effect at so slow a rate they will not contribute any audible difference to the sound of the output.

But when feedback is applied to the amplifier, all these time constants interact so as to make the amplifier almost into a low-frequency oscillator. It does not quite oscillate, otherwise the amplifier would be audibly unstable, but any of these transients coming along will set it into a momentary state of oscillation, which takes a few seconds to die away.

The oscillation itself is not audible, because it is only at one or two cycles and the output transformer prevents any appreciable voltage at this frequency appearing across the loudspeaker voice coil, also the loudspeaker does not produce appreciable response at this very low frequency. However, the low-frequency fluctuation occurs at measurable amplitude at some point inside the amplifier circuit itself.

The asymmetrical kick given by the program waveform can set up an oscillation twice as big as the effective DC component. This means that quite a large fluctuation can occur inside the amplifier which will not be audible outside of it.

So why does it cause trouble? Because the gain of every stage in the amplifier varies with operating bias. This low-frequency fluctuation is like a periodic changing of the bias of several stages through the amplifier.

INTERMODULATION

Consequently the program material gets modulated at this low frequency. What we hear, then, is due to an intermodulation of the program material by this low-frequency oscillation.

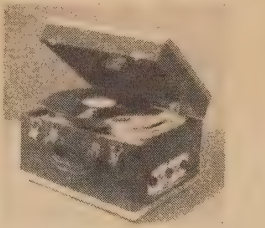
If the feedback were not present (which, of course, is an impossible state to imagine, because the feedback is what is causing the oscillation), the effect most noticeable would be that the whole program would sound as if an electronic tremolo had been added. However. the presence of a large amount of feedback stabilises the gain of the amplifier so the tremolo effect is not noticeable.

Instead, the same intermodulation that would cause a tremolo effect, but for the feedback, produces a much larger amount of IM distortion in the amplifier than occurs under static measurement conditions.

This results in the harshness often observed in modern feedback amplifiers.

(Continued on Page 89)

MOTOR SPARES LTD



New Model Record Player Amplifier

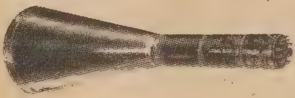
Very compact and light weight. This unit combines a 4½ watt amplifier with two inputs, one for the built-in 3 speed Philips record player and one for a crystal microphone; each input has its own volume control. Also two outputs, one connected to the built-in speaker and one for a separate extension speaker. Also an on-off switch and tone control is provided. The cabinet is finished in two-toned leatherette. Ideal for parties or for playing records in the home.
Well worth 35 gns.

Price only 27 Gns.

6in extension speaker in leatherette-covered box. Worth £3/4/-.

Our price 49/6.

Crystal Microphone to match this unit. 45/-.



Cathode Ray Tubes and Radio Valves

Type VCR 138 3½in diameter cathode ray tube, ideal for oscilloscopes, etc. Characteristics —

Filament Volts 4
Filament Current 1 amp
Anode 2 200 volts
Grid 1-50 volts.
X Plate sensitivity .14
Y Plate sensitivity .33
Anode 3 1200 volts
Electro-static deflection
Colour Green

Socket connections can be supplied to each purchaser.

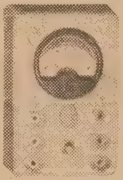
Price 32/6

Radio Valves in new condition

6K7G	7/6	IF5G	7/6
6V6G	9/6	1H6G	5/-
6K8G	10/-	1C7G	7/6
5B8G	9/-	6N7GT	10/-
EB34	5/-	6U7G	7/6
D5GP	5/-	807	17/6

The following tubes are brand new and boxed

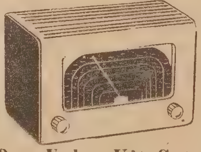
EF50	8/6	954	5/6
866A	29/6		



Chieftain Multimeter

An ideal pocket-sized meter in a plastic case, overall sizes 5¼ x 3¾ x 2⅜in. The meter has 100 ohms per volt sensitivity. Voltage readings are 0-15, 0-150, 0-300, 0-600 and ohms scale reads 0-100,000 ohms. This multimeter is ideal for the hobbyists, motor mechanic, radio serviceman and electrician.

Price only £4/12/6



One Valve Kit Sets for the Learner

Although this little set is quickly and simply built it looks like a factory job. The wooden cabinet is covered with burgundy leatherette and the dial has all Australian Stations marked in different colours. Parts are mounted on a wooden baseboard and any one can build it if they can use a soldering iron; Circuit diagrams wire, solder, etc, supplied. Price of complete Kit of parts including Valve Headphones and Batteries. Normal Price £8/5/-.

Our Price £5/19/6

SPECIAL NOTICE

All parcels sent Registered Post unless otherwise stated. Postage or Freight must be included with order.

★ SPECIALS ★

1. Padder Condensers to suit 455KC Osci lator circuits, adjustable. Worth 2/9 **Our price 1/3.**
2. Ferroxcube Rod Aerials with coil, ideal f portables and mantel radios. Equal to 60ft outdoor aerial. **Price only 16/6 ea.**
3. Metal Cabinets for table-model radios finished in mottled cream, size 14 x 7 x 6¾. These are suitable for replacing broken bakelite cabinets on many older radios. **Price only 10/- each.**
4. Ribbed Bakelite Coil formers 1¼in diameter, ideal for short wave coils.
   - 4 pin .. .. **2/- ea**
   - 5 pin .. .. **2/3 ea.**
   - 6 pin .. .. **2/6 ea**
   - 7 pin .. .. **2/9 ea**
5. Army Morse Keys new cadplated on bakelite base **2/9 each.**
6. Carbon Resistors in bundles of approximately 100 resistors ½ watt assorted values **10/- packet.**
7. Carbon Resistors in ½lb bundles assorted ½, 1, 2 Watt, assorted resistance values **Only 12/- packet.**
8. Low tension Iron Cored filament chokes. As used in vibrator radios. These may be rewound to make many different types of transformers, power, filament, audio output etc Worth 25/-. **Our price 2/6 ea**
9. Metal Boxes with lid and carrying handle. size 6" x 6" x 6½ in. in good condition **Price 3/6 each.**
10. Metal Boxes with Lid and carrying handl size 7½in x 6in x 6½in in good condi tion **Price 4/- each.**
11. Electrolytic Condensers 10mfd 40 PV Brand new, well known make. **Only 6d. ea**
12. Brand new power transformers, well know make vertical mounting.
    Primary 240 volts.
    Secondary 385 volts aside, 100ma,
    filaments 2-6.3 volt and 1-5 volt
    Worth £4/15/- **Our price £3/2/6 ea.**
13. ITS 7267 Output Transformers Approx impedances are: Primary 5000 ohms — Secondaries 2 ohms and 500 ohm line Power 10 watts. **Price only 25/- each.**
14. 5684-0 Power Transformers —
    Primary 230 volts.
    Secondary 300 volts aside—60 ma.
    filaments 4 volts and 5 volts 60 ma
    Only 19/6 each.
15. 6in Bakelite Speaker Boxes. Round, ideal for wall fittings etc. for extension speakers **Price only 4/- each.**
16. .5-400 volt tubular condensers. **1/- each**
17. Ferrocart PM 957 Vibrators. 12 volt Synchronous split reed with octal base Socket connections on application. **Price only 10/- each.**
18. Block Condensers, all brand new, in goo condition.

.1-500 wkg	1/- ea.
.1-800	1/3 ea.
.1-1500	2/- ea
.1-4000	5/6 ea
2 x.1-1500 test	1/- ea.
.25-1500 test	1/- ea
.25-2000 wkg	2/3 ea.
.5-1000 Test	1/- ea.
.01-5000 wkg	5/6 ea.
4 mfd-800 wkg	6/9 ea.
4 mfd-500 wkg	3/9 ea.
.00017-4000 wkg	2/3 ea.
.25-8000 Test	3/- ea.

19. High Tension Power supply transformers These give 2000 volts DC to work VCR97 or 5BPI for oscilloscopes or T.V. Sets Circuit for the high frequency power supply with each transformer. **18/6 ea.**
20. 5 Button Push Button Switch Units. Each unit consists of 4 push type 2-way switches and 1 DP ST push type switch. Ideal for intercom phones and speakers, also station selectors in radio receivers. **Price only 7/6 each.**

547 ELIZABETH ST., MELBOURNE ALSO AT — ALBURY ARARAT BAIRNSDALE BALLARAT BENALLA BENDIGO BOX HILL COLAC DANDENONG ECHUCA SALE FRANKSTON GEELONG MILDURA SHEPPARTON ST. ARNAUD WAGGA WANGARATTA WARRAGUL

O AMPLIFIERS SOUND DIFFERENT!

(Continued from Page 87)

e observations are not just the of theorising. To substantiate vo amplifiers of conventional de- ere taken and modifications made g their designs into line with the hed mathematical theory, giving quired stability margins at both f the frequency response to avoid g under any circumstances.

e changes resulted in a slight de- ion of the frequency response. neither instance did the response elow 1 db at 30 cycles or 15 kc.. is still considered to be high . It is doubtful—extremely doubt- hether a difference of 1 db at 30 cycles or 15 kc, could pos- e heard "for itself alone." A-B were then conducted between the ers, using their original circuits e revised feedback circuits.

ifference was quite noticeable in production of program material, larly with the kinds of program al in which, as has been discussed, is asymmetrical waveform—when nstruments are playing, or string nents are played by plucking.

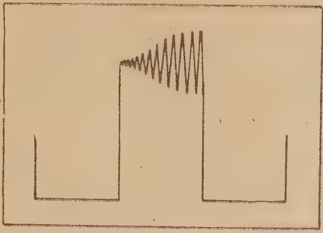
se experiments certainly seem to uncovered at least some of the differences that can exist between ers with equally good specifica- -differences that do not show up. rate, in the standard method of cation. These are, in fact, de- hat are not in the book!

y special arrangement with Radio elevision News.

EDITOR'S NOTE

Mr. Crowhurst's article raises some very pertinent points. Nearly all of them have been dealt with in our columns over the last few years as the result of amplifier tests made during the design and development of Playmasters.

His final point concerning motoboating being caused by a type of high frequency oscillation was very neatly illustrated by an oscillogram tracing which appeared on page 83 of last month's issue, and which is reproduced here.



This tracing showed what remained of a square wave pattern after passing through an amplifier which went into supersonic oscillation on one-half of the input cycle. This amplifier exhibited incurable low frequency oscillation at the same time.

In discussing the reasons for this, we advanced the same explanation as Mr. Crowhurst, and it would be hard to imagine a more effective example of it.

His point about the danger of large amounts of feedback causing instability due to peaks, which are apt to grow at supersonic frequencies, was made some years ago during a series of amplifier tests using the ultra-linear circuit.

This is one reason why we have always advocated restricting single-loop feedback to a maximum of 20 db,, particularly as home built amplifiers are liable to use output transformers of differing characteristics.

EXTENDED RANGE

His comments about the wisdom of using extended range output transformers, apparently apply to components of poorer quality than the best obtainable in Australia. Our transformers are expensive, and probably are included in the class Mr. Crowhurst considers are "prohibitive," but by the time labour and materials are paid for in our smaller factories, there is little to be saved by skimping on design.

In practice, we find that, provided there are no sudden peaks of appreciable amplitude which require considerable compensation, our amplifiers have an adequate safety margin.

But with very large amounts of feedback this may not be the case.

A perfect transformer with a completely flat frequency curve, of course, could accommodate an almost infinite amount of feedback without instability, limited only by possible phase shift in the amplifier itself.

YOUR

BRAIN

CANNOT

THINK!

It is merely the vehicle through which YOU direct every action of your life.

Like an electric motor, it has to be activated by an outside energising force. Your thoughts are but the **inner** expression of your will directed through your brain to the **outer** achievement of your desires and your ambition for greater achievement in life. You can learn how to direct your thought energy towards a specific objective to produce positive results. Learn how to marshal your mental powers to improve your business and social career.

The Rosicrucian teachings enable intelligent men and women to benefit almost immediately from the guidance of great intelligences who have progressed far beyond the boundaries of conventional study. If you sincerely feel you are now ready, with an open mind unfettered by orthodox prejudice, to accept new and absorbing truths, write for our free 32-page book, "The Mastery of Life." Dedicated to an inspiring objective, the attainment of the universal Brotherhood of Mankind, the Rosicrucians are a Non-Religious, Non-Political, Non-Profit Making Fraternity.

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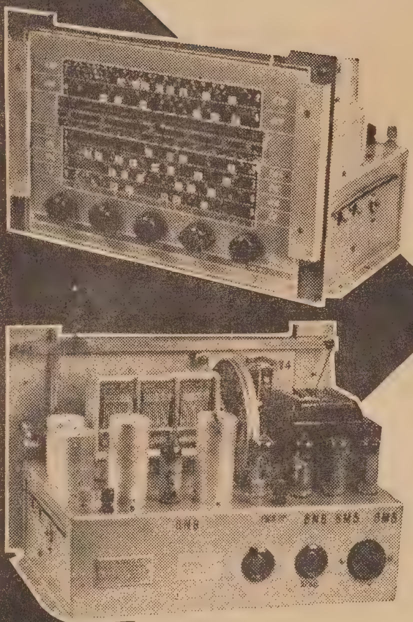
and compare these NEW features..



NEW:

Ultra modern circuit using nine high gain valves including "mag
eye" tuning indicator. Permatuned iron cored coils and inte
mediates giving excellent interstate reception and a short wa
range of 12,000 miles All valves used are the new Philips ni
pin innoval series

NEW:

Tone control and audio stages incorporating the Mullard 5/
amplifier circuit with separate bass and treble controls giving
or — 15db. boost or cut at 50 cycles L.F. and 10,000 cycles H.I
combined with push-pull output with inverse feed-back gives y
really high fidelity reproduction from your radio or favorite recor
ings.

NEW:

Dual speaker combination using a heavy duty woofer (12in M.S.
Jensen AU54 special) with matching 6in tweeter and cross-ov
network giving a frequency response of 46 to 13,000 cycles. Speake
are mounted coaxially making only one 11in mounting hole nece
sary.

If required the new Magnavox high fidelity twin coned speaker c
be supplied

NEW:

Large calibrated edge-lit dial in plate glass (11in x 7in) with ma
stations of each State in prominent type. Dial fitted with counte
weight drive giving smooth tuning Indicator lights are fitt
showing which band is in operation Dial can be supplied
cream, black or brown with matching knobs and escutcheon
suit contemporary blond or walnut finished cabinets.

NEW:

Sensitive "magic eye" tuning indicator (EM80) making tuni
simple and positive even on interstate, overseas and count
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All chassis are wired for the fitting of an F.M tuner or tape
corder, special plug being provided on back of chassis, also pick-
terminals and outlet for gramo motor.

Power switch is fitted to volume control, radiogram switch co
bined with wave change switch Audio end of set can be us
with T.V receiver if required

ALL CHASSIS GUARANTEED FOR A PERIOD OF 6 MTHS.

A NINE VALVE HIGH-FIDELITY RADIOGRAM CHASSIS

Nine and ten valve chassis incorporate the Mullard 5-10 AMPLIFIER CIRCUIT Frequency response 40-13,000 cycles. Max output 10 watts.

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WITH BASS AND TREBLE BOOST.

The ideal chassis for those difficult locations where reception is doubtful. Specifications as nine valve unit, but with the addition of high gain tuned R.F. stage giving greater sensitivity and selectivity on both broadcast and short wave bands.

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RECORD PLAYERS AND CHANGERS

We have a complete range of 3-speed record playing equipment, including Dual, Collaro or Garrard Players, with turn-over crystal pick-ups or your choice of Garrard, Stromberg-Carlson, Collaro or the new Dual 3-speed changer that will play 7, 10 or 12in records intermixed All changers have turn-over Crystal pick-ups.

Write for full specifications

Classic Radio

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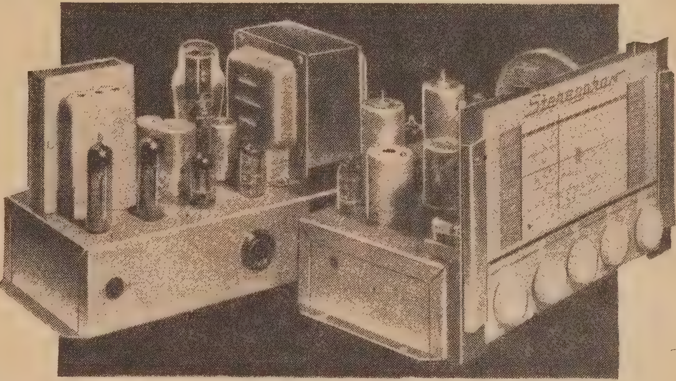
CLASSIC RADIO TAKE PRIDE IN ANNOUNCING TWO NEW ADDITIONS TO THE ALREADY FAMOUS LINE OF HI-FIDELITY RADIOGRAM CHASSIS.

Stereophon

LIVING SOUND

A compact 11-Valve High-grade Radiogram in two chassis, featuring a variable bandwidth Tuner, multi-input preamplifier and Tone Control in one unit, and a 10 Watt Ultra-linear Amplifier. Ideally suited for use with High-grade Pick-ups and Speakers.



SUMMARY OF PERFORMANCE

TUNER:

Broadcast Band. 2 position Bandwidth, whistle filter, EM80 Tuning Indicator attractive Dial

PRE-AMPLIFIER:

Microphone input sensitivity	1.5 mV
Pick-up input: 1. High sensitivity	5mV.
2. Low sensitivity	50mV.
Tape or T.V. input sensitivity	100mV

All inputs controlled by one 6-position functional switch Power switch on Volume Control.

TONE CONTROL:

Separate Bass and Treble Controls giving 20db boost to 18db cut for both controls. R.I.A.A. Equalisation for L.P and E.M.I Equalization for 78 records

AMPLIFIER:

10 Watt Ultra-linear with Ferguson O.P. 301 Output transformer 6BQ5 output valves

Frequency response 30-20,000 cycles + or − 0.5db

Harmonic distortion better than 0.1 per cent.

Output impedance 15 ohms or as required.

QUALITY never before at this PRICE

65 GNS.

NEW SEVEN-VALVE HI-FI CHASSIS

THIS NEW COMPACT DUAL WAVE SEVEN VALVE CHASSIS USES THE SAME TUNER CIRCUIT AS OUR 9 VALVE UNIT. WITH THE MULLARD TONE-CONTROL CIRCUIT GIVING SEPARATE BASS AND TREBLE CONTROLS. PUSH-PULL OUTPUT USING TWO OF THE NEW 6BM8 DUAL PURPOSE OUTPUT VALVES AND HEAVY DUTY M.S.P. SPEAKER.

£29/18/- F.O.R. PACKING 10/- EXTRA

ALSO AVAILABLE WITH MAGNAVOX 12W.R. HI-FI SPEAKER AND FERGUSON OUTPUT TRANSFORMER AT £4/15/- EXTRA.

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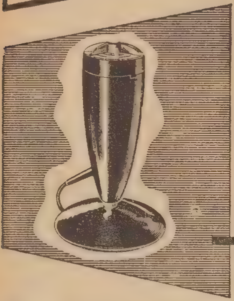
ACOS

A COMPLETE RANGE

CRYSTAL MICROPHONES MICROPHONE INSERTS

FOR EVERY PURPOSE



DESK or HAND MICROPHONE, MIC36

This Microphone is ideal for home recording and public address, etc. Response unexcelled for its size and price. The performance is not affected by vibration, shock or low frequency wind noise. Omni-directional frequency response substantially flat from 30 to 7,000 c.p.s. Recommended load resistance not less than 1 megohm, dependent on low frequency response. Can be supplied complete with switch and floor stand adaptor, as required, at a small extra cost. **PRICE, £6/18/6.**

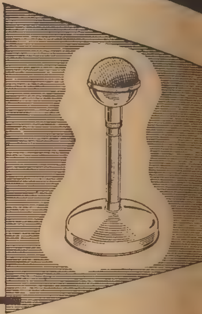
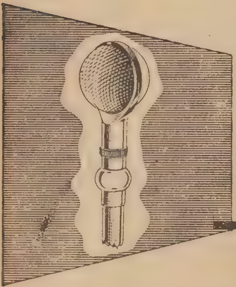


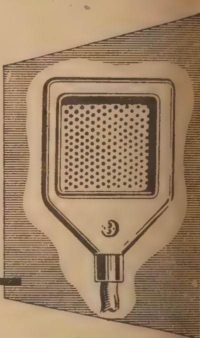
TABLE or STAND MICROPHONE, MIC22

This omni-directional Microphone is robust in construction, with a pleasing appearance. Vibration, shock or low frequency wind noise will not affect the performance. The low frequency cut-off is dependent on the load resistance. The cut-off is given by the equation, F = 80 divided by R, where F = c.p.s., R = megohms. An adaptor (floor mounting) is available at low extra cost. **PRICE, £9/18/6.**



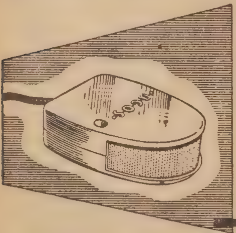
HIGH-QUALITY MICROPHONE, MIC16

This Microphone incorporates the world-famous floating crystal sound cell construction. Its fine performance is not affected by vibration or shock. The fidelity is not impaired by low frequency noise. **PRICE, £24/19/6.**



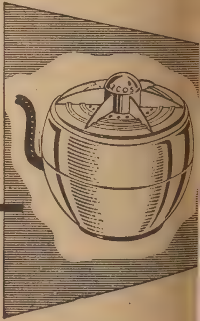
LAPEL MICROPHONE, MIC28

Designed to give freedom of movement, this Microphone is small and non-directional. Housed in a soft, moulded-rubber case, which gives protection against shock, it is provided with a pin at the rear of the case for pinning to the lapel. **PRICE, £5/19/6.**



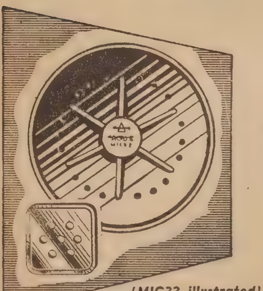
GENERAL PURPOSE, MIC35

The MIC35, is ideal for amateur transmitters, public address, etc. Housed in an attractive die-cast case, it features a high sensitivity and substanially flat characteristics. Provided with a built-in shunt resistance of 2 megohms, it will, when connected to the grid of the input valve, give a substantially flat response from 50 to 5,000 c.p.s. **PRICE, £2/15/-.**



HAND or DESK MICROPHONE, MIC33

This Microphone has been designed for the high quality public address and home recording field. High sensitivity and flat characteristics are obtained by a specially designed acoustic filter. Housed in an attractive plastic case with an unexcelled response for its size and price. Unaffected by vibration, shock or low frequency wind noise. Omni-directional frequency response substantially flat from 30 to 7,000 c.p.s. **PRICE, £6/18/6.**



(MIC32 illustrated)
(MIC23 illustrated)

CRYSTAL MICROPHONE INSERTS

These inserts are available in varying sizes, ranging from as small as $\frac{15}{16}$ in. square to 1-$\frac{13}{16}$ in. round, with various thicknesses from $\frac{7}{32}$ in. to $\frac{3}{16}$ in. Suitable for every purpose, such as hearing aids, public address, tape recording, amateur transmitters, etc., they have responses from 2,250 c.p.s. to 3,500 c.p.s. at -5 db to -30 db. Insert can be supplied with or without 10 meg. resistor as required.

MIC19/4 and MIC32, **£2/15/6**; all others, **£1/19/6.**

Sole Australian Agents:

AMPLION (A'sia) PTY. LTD. 88 Parramatta Road Camperdown, Sydney, N.S.W. Phone LA 6124.

Victorian Distributors: DISTRIBUTORS CORPORATION, 403 Bourke Street, Melbourne.

Here's your answer, Tom!

m's first worry, this month, concerns the different classes of operation for power amplifiers. We answered an exactly similar question for a reader some years ago but, since it is of wide interest, it may be well worthwhile to repeat the answer.

PARENTLY Tom has been read- g through some of our technical s, where the term "Class-A ampli- lass-B amplifier" and so on occur regularly.

hat is the difference between B, AB1 and C classes of opera- in power amplifiers?

might suggest, rather facetiously, ias problems are far older than itself. As long as children have n the world they've pestered their s with the oft-repeated request to this" or "bias that."

n the radio sense, bias is a lot rer than it ought to be, because nefits were not generally appreciat- il well after the amplifying triode ome into use.

MPLIFIED!

hose days, it was wonder enough a small signal could be fed to id of a valve to produce a much signal at the plate. It was of lary importance that the signal omewhat blurred—the main point hat it was loud!

blurring of the signal which w more correctly call "distortion" argely due to the fact that the did not amplify the incoming sig- ithfully. The signal wave patterns be fed to the grid in a fairly orm, only to emerge from the plate with the tops flattened, the sides and so on.

t was then discovered that valves amplify more faithfully if a small ve voltage was applied to the grid his came to be known as the "grid voltage.

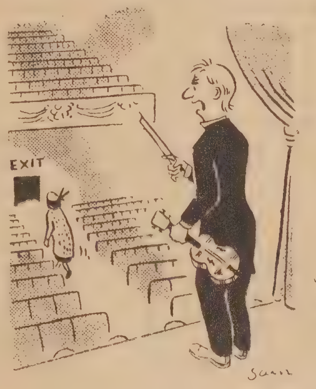
ce then we have learned a lot about the use of bias. Instead ling an afterthought, it is one of itally important operating poten- s for a valve. Just as you arrange e appropriate filament and plate es, so must you apply the correct if the valve is to operate properly.

w this class A, class B, class C ss has nothing to do with the of the valve, but describes the l condition under which the valve operate. Why the terms should been chosen, goodness only knows, hen why should we call a thing six legs an insect? It's just a , after all.

wever, when the bias is adjusted valve so that it amplifies faithfully hole of the input signal wave, the never actually going positive with t to cathode, we say that the valve erating under class A conditions.

st of the valves in an ordinary perate under class A conditions, irrespective of whether they are amplifying at radio, intermediate or audio frequencies. If something were to upset the operating conditions of one or more of these amplifying stages, the signals would become distorted. You've learned the first point.

In the course of time, it was also discovered that valves could be operated in pairs in what is now called the "push-pull" circuit. The immediate benefit of such an arrangement is the ability of the valves to deliver much louder signals than a single valve working alone in the output stage of a receiver.



"Mother! I haven't finished yet!"

It was also noted that the power output, or loudness of the signals, could often be increased by making the bias more negative than normal and feeding the grids with such a strong signal that they were actually driven positive on signal peaks.

In actual fact, the bias was made high enough so as to cut off almost completely the initial flow of plate current, so that economy of battery drain was one of the powerful "talking points" for this class of operation in the early battery sets.

Distortion is avoided, despite the high bias, because the two valves have a complementary action, each one amplifying faithfully the respective halves of the input signal.

The technique of operating valves with an abnormally high bias and driving the grids harder became known as class B operation.

Of course, that isn't the end of the story, Tom. The valves have to operate into a suitable order of load and the driving signal must come from a stage which is, itself, capable of delivering a certain amount of power. Fortunately, you don't have to work these things out yourself, because the necessary bias, HT voltage, driving power and so on, are listed by valve manufacturers in their valve manuals.

Compromise conditions have been worked out for modes of operation which lie between pure class A and pure class B operation. These, appropriately enough, have come to be known widely by the terms class AB1 and class AB2.

In both cases the negative bias is greater than would be expected for class A operation. With class AB1 the grids are never driven substantially positive and the previous stage is not called upon to deliver any substantial power to the push-pull grids.

DRIVEN POSITIVE

With class AB2 the grids are driven well positive on peaks and the drive requirements are similar to those for pure class B, the point of difference being that the initial bias is not as high as would be required for class B.

Class C is a special operating condition which is used mainly in transmitters.

In a class C stage the grid is initially biased to well beyond cut-off but is driven positive on the extreme peaks of the input signal. Those are the general facts, Tom, but there are a few points which might confuse you. For example: not all valves working under class B conditions have a high applied bias. In fact, some operate with no bias at all.

As mentioned previously, almost twice the bias of a class A stage is required for class B operation and this will normally be sufficient to cut off the flow of plate current in the absence of signal.

When a valve has a relatively low amplification factor, as is often the case with power output valves, quite a large bias is required for class B operation and this is sometimes quite awkward to provide.

Recognising this difficulty, the valve designers have produced, from time to time, valves which have so many turns on the grid that it severely restricts the natural flow of electrons to the plate. Even with no negative bias on the grid, the plate current in such a valve might be quite low. In other words, it satisfies the class B requirement of being biased to cut off even with zero grid bias.

The moment a signal is applied, it drives the grid positive on the positive peaks and the rest of the bargain is ful-

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Such valves, of course, are not le for class A operation because are always at cut-off.

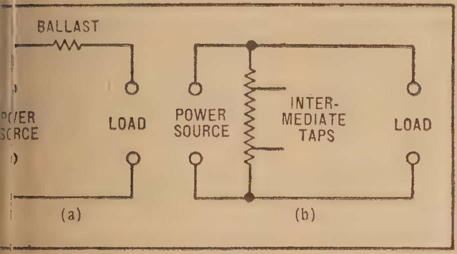
A class C stage does not amplify in e normal sense of the term. It , rather, to deliver abrupt and ful bursts of signal to a tuned t and keep it oscillating at its al resonant frequency.

just like the pistons of a motor r. They don't deliver all the time, only in bursts during the power . The big flywheel alternately and delivers energy and transmits atively smooth drive to the rear s.

★ ★ ★

s a "ballast resistance" the same a "voltage divider"? If not, ase explain their difference.

e term "ballast resistor" is usually d to a resistor with a high temure coefficient of resistance, used aintain a constant current in spite otlage variations.



A ballast resistor (a) tends to maintain constant current through the load circuit. A voltage divider (b) provides intermediate voltages between maximum and minimum.

l plain words, Tom, a ballast resisr is made from a metal alloy which the characteristic of increasing its stance with an increase of the curn flowing through it, due to the heatwhich takes place.

e increase in resistance causes an case in voltage drop across the re which, in turn, decreases the curn flowing through it, thereby tending eep the current more nearly con.

arretters and such-like devices are known examples. A barretter, example, consists of an iron-wire ment in a hydrogen-filled glass enpe and looks like a "cross" between ordinary incandescent lamp and a valve.

rdinary resistors are sometimes red to as ballast resistors, a well wn example being the ballast rer in a battery charger. Its pur is merely to limit maximum cur.

voltage divider is usually connectd in parallel rather than in series the supply. Its prime purpose is rovide one or more taps so that the ge between these and one end of resistor may be varied. The current ing from these points through an rnal circuit is a deciding factor as he value of resistance required for iven voltage drop.

★ ★ ★

Is the gain of a valve the same the mutual conductance?

o, Tom. Although intimately coned, they are not the same thing. n is a pretty general term used in age amplifying stages to denote the of output voltage to input voltage.

On the other hand, in a power output stage we are primarily interested in the power available to drive a loudspeaker for a given signal input voltage.

The gain of valve amplifying stage is dependant on three main factors, the valve's own plate resistance, the plate load resistance and the mutual conductance of the valve.

An increase in any one of these quantities will tend to increase gain, so that all three have to be considered in determining the final figure.

The most that one can say is that a valve having high mutual conductance will end to give higher gain than one having low mutual conductance, all other things being equal.

★ ★ ★

What is the difference between a modulated oscillator and a signal generator? What are they used for?

Generally, the term signal generator refers to the better-class instrument, while a modulated oscillator describes a less pretentious instrument of the same species.

Both instruments generate frequencies, from the superhet IF channels to high radio frequencies which allow one to align the tuned circuits of a receiver to their correct frequency of operation. In the case of the signal generator, we would expect to find reasonably accurate frequency calibration and, even more important, an accurate means of measuring the voltage output of the instrument at all times.

When measuring the performance of highly sensitive modern receivers, the leakage of the attenuator must be very low.

Most signal generators make provision for modulation either of fixed or variable frequency and also provide for adjusting the modulation to known depths.

An oscillator, on the other hand, consists simply of a valve working as a radio frequency oscillator and usually covering from about 150 Kc to, say, 30 Mc with a dial giving the approximate frequency and some simple form of attenuator, the latter not generally calibrated to any degree of accuracy.

An audio frequency oscillator is usually provided for modulation purposes, but the percentage of modulation is not accurately indicated.

In general, an oscillator is quite suitable for adjusting domestic receivers, but a signal generator is required for making accurate performance measurements and for adjusting more elaborate equipment, such as communications receivers.

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A COURSE IN TELEVISIO

PART 22 — VIDEO AMPLIFIER STAGES

Next step in the study of television receivers is to discuss the subject of video amplifiers. While they are often compared in function to the audio amplifier in an AM broadcast receiver, the comparison can only be superficial, the design of a video amplifier involving distinct and unique problems.

BY way of definition, the video circuits in a television receiver are those concerned with amplifying the signals, which emerge from the video detector, to a degree where they can modulate fully the intensity grid of the picture tube.

They are therefore broadly synonymous with the audio amplifier circuits in a sound receiver, which take the signals emerging from the detector and amplify them to a level sufficient to operate a loudspeaker. There the likeness ends, however.

Whereas audio circuits are concerned with frequencies only up to about 15Kc, video amplifier circuits should ideally be able to handle all picture frequencies radiated by the transmitter and these extend to about 5Mc.

UPPER FREQUENCY

In other words, a video amplifier should be able to handle, as a matter of course, frequencies ranging up to three times those used for the carrier itself, in ordinary broadcast-band transmission. Its bass response must also be better than that of a conventional audio amplifier.

This is the first major requirement. If the overall pass-band of the video system is not wide enough, the picture quality must inevitably suffer through loss of shading and fine detail.

A second requirement is that, notwithstanding the wide pass-band, a video amplifier must be capable of providing the requisite gain and output voltage to vary the picture tube scanning beam intensity between zero and the maximum required figure.

Lack of gain, in association with the rest of the receiver, will prevent a picture being presented having the full range of tones from black to white. The effect is most noticeable, of course, with weak input signals.

As distinct from gain, insufficient signal output voltage, leading to non-linear effects and overload, can likewise impose limits on the tone range of the picture. Attempts to obtain greater contrast in the face of such limitation merely causes more of the picture area to merge with limiting tones at one or both ends of the tone range.

What happens, very simply, is that the video output stage overloads and "flattens off" before it can carry the writing beam to one or both of its normal intensity limits.

Picture tube grid signal requirements vary a good deal with the type of tube, operating potentials and viewing conditions but peak-to-peak signal requirements may approach 70 volts.

It should be noted, in passing, that signal levels in the video, synchronising and deflection circuits are normally specified in terms of peak-to-peak voltage. This is necessary because, with the non-symmetrical, angular waveforms involved, simple peak and RMS quantities are meaningless.

Over and above the basic requirements of frequency response, gain and output voltage, various other important matters have to be considered.

These include: (1) The possible need to provide video gain control; (2) A choice as to the number of video stages which can conveniently be provided; (3) The observation of correct polarity for the picture signal; (4) The preservation or otherwise of the DC component.

Certain of these points have already been covered in earlier discussion but may warrant some repetition in this present context. Firstly, the matter of signal polarity:

With negative modulation, the darker picture areas produce increased carrier amplitude, peak amplitude or power occurring during synchronisation pulses. This means, in turn, that the detector delivers high output voltage at intervals when a "black" signal is being received.

NATURE OF CIRCUIT

In modern receivers, the detector is almost invariably a thermionic or crystal diode and the polarity of its signal output in respect to chassis depends on which way round it is connected into circuit and/or whether the load resistor is placed in its anode or cathode return.

During intervals when "black" or synchronising signals are being transmitted, the detector may therefore deliver maximum positive-going or maximum negative-going signal voltages across its output load resistor.

When the detector is polarised to give peak negative output on synch. pulses, it may be said to be delivering a signal of "negative synch. phase" or "positive picture phase." Both expressions describe the same condition and merely indicate that the synch. pulses are negative-going in sense while the picture information is simultaneously positive-going, both referred to chassis potential.

Reversing the detector would reverse the sense of its output signal, so that it could be described as "positive synch. phase" or "negative picture phase."

The same terminology can be used, if desired, to describe the signal throughout the entire video system.

In a practical receiver design, the polarity of the detector may well be dictated by the need for it to produce simultaneously a negative DC potential for the automatic gain control syst Where such is the case, the desig must arrange the number of vi stages and the signal feed to the ture tube to ensure a "positive" im on the screen.

Were the signal applied to the pic tube to have the wrong polarity, modulating action on the writing be would be reversed. Dark areas wo become highlights and vice versa, ducing a photographic "negative" rat than the desired image.

The matter of signal phase is theref vitally important in a video sys whereas, in audio practice, it is of special consequence.

A normal resistance-coupled vi stage, with input to the grid and out taken from the plate, produces a ph change approximating 180 degrees. T a detector signal, which is negat going on peaks, becomes positive-go after traversing one such stage.

A second video stage of the same t will produce a further 180-degree sh making 360 in all and reverting the sig to the same sense as from the detecto

If a video stage is operated as cathode follower, the phase of input output signals is nominally the same

Also significant in the matter phase is the signal feed circuit to picture tube. Most, if not all, mod picture tubes have a specially insula cathode giving the same order of in capacitance as the intensity grid its

By way of example, the 17HP4-B an input capacitance, grid to all ot electrodes, of 6 pf, while cathode to other electrodes is 5pF.

To produce a darkening of the tr on the screen, it is necessary to imp a negative-going signal on the inten grid, the cathode meanwhile being h to chassis potential as far as the sig frequency is concerned.

SIGNAL PHASE

Since it is necessary to darken the tr for "black" signals or during the tra mission of synch. pulses, it may be that a picture tube, at its grid, need signal of "negative synch. phase" "positive picture phase."

Conversely, the same effect on beam can be achieved by holding grid at chassis potential for the sig frequency and applying a positive-go signal to the cathode.

Thus, for cathode signal injection picture tube requires a signal of "p tive synch. phase" or "negative pic phase."

Wh it is perfectly practical to feed veo signal either to grid or to aod, one particular factor favours lar consideration. This arises from oprating condition of the final video plir.

Wh this operates nominally as a s voltage amplifier, conflicting re- ernts of gain, bandwidth, output eonomy normally prevent the pro- onf any great overload margin. The e ay therefore have to operate into cved portion of its characteristic, icarly as the grid swings toward e irrent cut-off.

hi being so, it is an advantage to e is occur when the writing beam ei blacked out. On the opposite g when the picture tube is producing lits and therefore the most obvious ic of the picture, the video am- eris operating over the straightest ic of its characteristic.

T LINEARITY

tle thought will show that a posi- gng swing (positive picture phase) h grid of the final video amplifier, poduce increased plate current and ete a negative plate voltage swing. pd to the cathode of the picture e his negative-going signal will pro- e picture highlight, as required. The ti-going "black" and synch. peaks, sily subject to some non-linear dis- ic will produce little or no light th picture-tube face.

he considerations covering the sof the signal and the manipulations chare possible, result in a variety of circuit patterns for typical video ers.

Jroubtedly, the most common is a ecr producing negative-going sig- s n "black" peaks, together with a ate DC potential which is available, reired, for AGC purposes. The ecsignal is then passed through one pler stage, so that it becomes posi- ging on "black" peaks, this signal ngapplied to the cathode of the pic- be.

in more elaborate receiver, the de- ne may prefer to employ two video plier stages, for the sake of in- asl gain, more convenient gain con- , nore facility in the provision of ircuits and/or the achievement of de frequency response.

Tv stages, plate loaded and operating cade, would deliver an output sig- the same sense or polarity as the ou This would involve either re- rsig the polarity of the detector and edig the signal to picture cathode, or inining a negative-going signal from tector and feeding the video out- o the picture tube grid.

AHODE FOLLOWER

Y another possible arrangement is to two-stage video amplifier but with cond stage operating as a cathode llcer. Because this second stage in- odies no significant phase shift, the nvation is to have a negative synch. as signal from the detector, a positive no phase signal from the first video agand the same again from the second de stage, feeding the picture-tube th le.

★

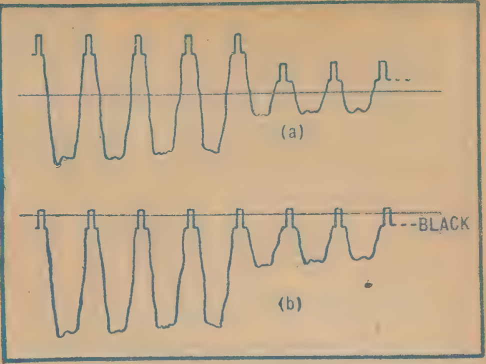

Figure 132: Though considerably exaggerated, diagram (a) indicates the nature of a video signal after loss of the DC component. Diagram (b) indicates the effect of DC restoration, the signal having the same character as that from the video detector.

★

An interesting variant of this scheme is to have the second of two video stages operating with part plate and part cathode loading. Output is taken from the cathode to the picture-tube cathode and from plate to picture-tube grid. Though more complex, the divided load idea allows the relevant circuit capacitances to be more or less connected in series across the total output circuit of the final video amplifier.

Typical circuits, illustrating these various arrangements, will be given later but enough has been said here to indicate the way in which consideration of signal phase dictates the basic pattern of the video circuitry.

It may be noted that no mention has been made of economy designs, omitting the video amplifier and feeding the detector output directly to the picture tube. Such receivers have, in fact, been produced using grid, anode-bend or reflex detectors.

NOT CURRENTLY USED

By and large, however, they were confined to the early English scene where there was no need to consider multiple channels, special pass-band characteristics or the use of automatic gain control. Nowadays, such designs are rarely encountered.

The significance of the DC component has already been discussed in an earlier article in this series. It was pointed out there that a video signal is nothing like an audio signal and is not symmetrical about some intermediate reference voltage. Rather must it be considered as a potential which varies in an abrupt, non-repetitive fashion, according to the variation in light and shade along each individual scanning line.

On this basic waveform is superimposed signals, artificially generated which are intended to synchronise the receiver scanning circuits with those at the transmitter, and to black out the viewing screen at the same time.

The instantaneous output from the receiver's video detector is — or should be — exactly proportional to the amplitude of the incoming picture carrier. The peak output voltage from the detector during synch. pulses will be constant for any given input signal, the general level of the video information between pulses rising or falling according to whether the picture content is light or dark or just average.

In other words, the basic output from the video detector is a DC potential which is subject to very rapid and substantial fluctuation but which reaches a certain peak value during each individual synch. pulse.

In an idealised video amplifier, the signal never loses this basic character. The detected signal is directly coupled to the input of the video amplifier and appears at the output as an exactly proportional variation in DC level.

It is directly coupled, in turn, to the picture tube input circuit, either to grid or to cathode, as dictated by polarity requirements. Since the signal may be superimposed on the plate supply potential of the video output stage, the other picture tube electrode—cathode or grid — must be returned to a comparable potential so that the correct bias relationship will be established between the two.

Under proper conditions, the relationship between the signal and the standing voltages would be such that the beam would be visually extinguished at the exact instant when the incoming carrier amplitude achieved 75 per cent. of its peak value, corresponding to the official black level.

Increased carrier amplitude during synch. pulses would carry the picture tube even further into the cut-off region, while decreasing carrier amplitude would produce increasing screen illumination.

EFFECTIVE WHITE

The controls would normally be set so that the peak beam intensity, judged necessary to produce a visual sensation of white, would occur at a carrier level equal to 10-15 per cent. of maximum.

Unfortunately, the design of a directly coupled video system is attended by the usual difficulties of any DC amplifier, particularly where more than one stage is involved.

A plate, normally positive with respect to chassis, must be connected to a following grid which needs, in turn, to be less positive than its own cathode. These varying DC levels throughout the circuit have to be reconciled without prejudicing the operation of any one stage.

The circuit design, furthermore, has to be sufficiently non-critical to prevent normal component variation and drift in

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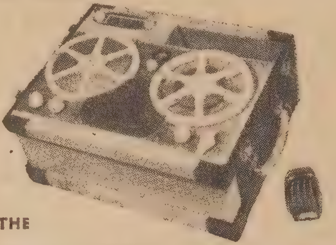

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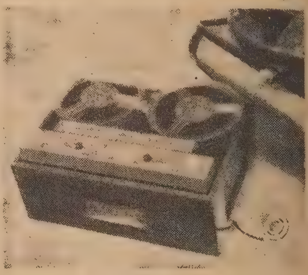

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part of the circuit from upsetting the voltage or current relationships in another.

Last but not least, the provision of Brightness and Contrast (i.e. video gain) controls may be hampered because of their possible reaction on the DC levels throughout the circuit.

OTHER PROBLEMS

Even if a change in DC levels is insufficient to distress a particular valve or component, it can cause troublesome interaction between the controls or [illegible] the potentials enough to prevent the blanking pulse from erasing completely the retrace lines.

Because of these difficulties, many designers do not attempt to maintain direct coupling right through the video system. They use it where it presents no special difficulty, resort to capacitive coupling where it suits them and then restore a DC component by the use of a DC restorer.

Readers are reminded that an article "The DC Component" appeared in the March 1957 issue and the phenomena detailed of DC loss and DC restoration.

Figure 132, reproduced herewith, will serve as a reminder. Though grossly exaggerated in effect, diagram (a) shows how video signal, after passing through an RC network, tends to equalise about the average reference, such that the area in the positive-going excursions [illegible] that in the negative-going excursions.

Diagram (b) illustrates the same signal after a DC restorer has aligned the sync peaks once again.

In many current receiver designs, AC coupling is used without any attempt being made to preserve or restore the DC component in the basic video amplifier. The scheme is claimed to simplify design problems without prejudicing the entertainment value of the picture.

The chief difficulty about simple AC coupling is that it allows some degree of error in the effective height of the blanking and synch. pulses, as illustrated in figure 132. Under certain signal conditions, as when the screen is predominantly dark, the effective amplitude of the pulses may diminish sufficiently for them not to blank out the beam during the retrace periods.

FRAME RETRACE

This is most objectionable in respect of the frame retrace, which might cause half-dozen or more lines to appear slantwise across the screen.

Where AC coupling is used in the video amplifier, with no DC restoration, it is therefore common practice to provide a built-in frame retrace blanking circuit. This involves a simple coupling circuit from the frame output transformer to the grid or cathode of the picture tube. The nature of the coupling and the polarity of the resulting signal must be arranged so that, during the [illegible] flyback pulse, the beam is momentarily blacked out.

The arrangement is similar to that used for retrace blanking in ordinary oscilloscopes.

AC coupling with retrace blanking appears to be favoured particularly in the U.S. It is suggested that this is partly due to failure of U.S. television stations to observe strictly official standards governing the ratio of blanking level to peak carrier power.

This creates obvious differences in picture quality and in the effectiveness of retrace blanking as a receiver is switched from one Channel to the next. Under such conditions, a receiver with AC coupling and built-in retrace blanking may have an actual advantage, as far as ease of operation is concerned.

Two points remain to be covered in this preliminary survey of video systems. The first is the Brightness control.

The essential function of this control is to vary the standing bias between grid and cathode of the picture tube and therefore the average brightness of the image on the screen.

Advancing the Brightness control reduces the standing bias between grid and cathode and makes all portions of the picture brighter, both the highlights and the shadows.

VARIES BIAS

In many cases, the Brightness control is simply a potentiometer which supplies an adjustable voltage to grid or to cathode through its normal return resistor. The most convenient arrangement is usually to have the cathode returned to a potentiometer connected in part between the HT line and chassis.

In special cases, the brightness may be controlled by varying a potential at an earlier point in a directly coupled video amplifier, the consequent change in DC level affecting bias on the picture tube.

As distinct from the Brightness function, a Contrast control must increase the difference in contrast between light and dark portions of the picture. This involves the application of a larger video signal to the picture-tube grid or cathode, as the case may be.

In some receivers, the Contrast control operates in the front end of the receiver. It may be a simple manual control varying the bias on certain RF or IF amplifiers or it may modify the AGC circuit to permit a larger signal to pass to the video detector and thence through the video amplifier to the picture tube.

GAIN CONTROL

In other receivers, the Contrast control operates purely in the video amplifier as a simple gain control

Here an immediate difficulty occurs, because the conventional scheme of using a potentiometer across the signal source, with the following grid to the moving arm, is quite unsuitable. At various settings, capacitance effects across the potentiometer are likely to give a rising or falling high frequency characteristic.

Difficulty also arises because the impedance between grid and chassis varies with pot. setting and, with it, the significance of valve input capacitance.

Alternative schemes must therefore be found, such as varying the screen voltage of a pentode amplifier or introducing a variable unbypassed resistor in the cathode return circuit. This latter operates largely by virtue of its degenerative effect, though it also changes the bias and current levels.

We shall have more to say about these matters in the next issue.

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403 New Canterbury Rd., Dulwich Hill, N.S.W.

TRADE REVIEWS AND RELEASES

"ADVANCE" CRYSTAL STANDARD CHECKS SIGNAL GENERATOR CALIBRATION

"Advance" Crystal Calibrator type 74 is intended as a calibration check for signal generators over the frequency range from 1Mc/s to 250 Mc/s and should be a useful addition to service departments and laboratories concerned with VHF communication and television equipment.

THE heart of the instrument is a 5 Mc/s crystal oscillator of high accuracy. A multivibrator operating at a fundamental frequency of 1 Mc/s is locked to the crystal oscillator and gives a series of accurate calibration points at 1 Mc/s intervals over the frequency range.

The output of the signal generator under test is fed to the input terminal of the crystal calibrator. Circuitry is arranged so that the incoming signal beats with either the 1 Mc/s or the 5 Mc/s oscillator or their harmonics. The output of the mixing stage is fed via a volume control and an audio frequency amplifier to either an inbuilt loudspeaker or a phone jack while a magic eye tube serves as a visual indicator.

According to the manufacturer's data the instrument is capable of an accuracy of better than plus or minus two parts in 10,000 plus or minus 15 c/s with the visual indicator. Accuracy is not quite as good with the aural indicator but the latter is extremely useful in establishing the approximate calibration point. Sensitivity is such that a satisfactory indication can be obtained with input signals having an amplitude of 10 mV or less.

The instrument was used in our own laboratory to check the calibration of a signal generator covering up to 300 Mc/s, and no difficulty was experienced in identifying calibration points at the high end of the range.

The price is £48/15/. Further information can be obtained from Jacoby, Mitchell and Co. P./L., of 477 Kent Street, Sydney.

Overall dimensions of the advance instrument are 7½in high by 7⅜in wide by 7in deep. The weight is 9lb.

*

LATEST PHILIPS TRANSISTORS

DATA on transistors types OC44
OC45 has been available for
time and it is pleasing to note tha
supply position is a little better
previously. The interesting tech
feature of these transistors is the
quency handling capability making
suitable for many applications previ
reserved for valves.

The OC44, for example, may be
as a mixer or oscillator in broa
band receivers while the OC45 will
efficiently at intermediate freque
The list prices are £2/17/9 fo
OC44 and £2/15/ for the OC45.

OC44 and OC45 are shown lar
than actual size.

Used in conjunction with trans
such as the OC71 and the OC72 a s
het broadcast receiver with perform
comparable or better than convent
valve portables is possible with the
transistors. Extremely compact p
radio receivers would also be pos

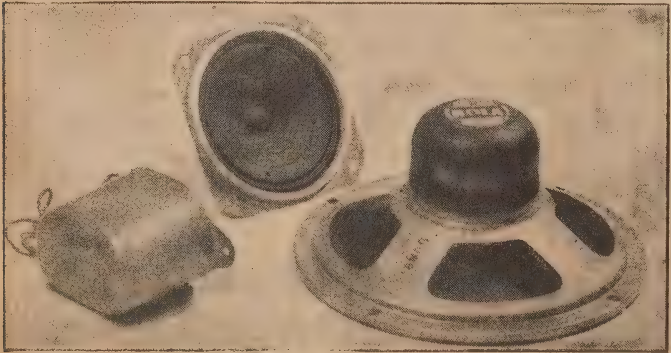
Transistor type OC16 may als
more plentiful in the future. Rec
revised ratings suggest that this type
be useful in the output stage of a p
address system operating from a v
battery without the need for a vib
or motor generator power supply.
list price is £5/18/4 per transisto
is offset by the saving in cost of
components and power economy.

TELEVISION SPEAKERS FROM ROLA

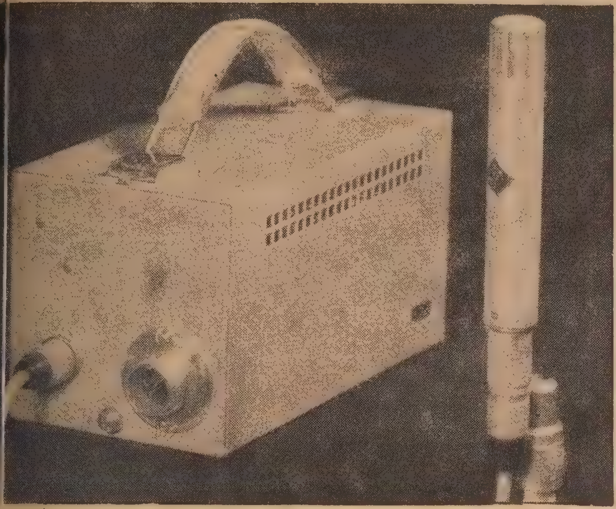
A POSSIBLE difficulty when loudspeakers are placed close to the picture tube in a television receiver is distortion of the picture due to the external field of the speaker magnet.

Both the 6M and the 3C models, illustrated here, are fitted with magnetic assemblies designed to cut external fields to a minimum and, therefore, are suitable for use in table model television receivers. A practical test indicates that the 6M can be mounted alongside the picture tube as specified in the R,TV and H design appearing in this issue.

Common practice is to use the 3in and the 6in speaker together in the one receiver, the small speaker being mounted in the front of the cabinet and the larger speaker on one of the sides.



BROADCAST QUALITY MICROPHONE



of a very comprehensive range of miniature high quality Neumann nser microphones was recently forwarded to us for test and examina- by Simon Gray Pty. Ltd. of Melbourne, the national distributors for rs. Georg Neumann G.m.b.H., Berlin. It is the model KM-54 which is photographed here with its associated power supply.

microphones are widely used in badcasting, television and record- lios, where good electrical char- cs together with reliability are of nce.

KM-54a is a pressure-gradient er microphone with a cardiod- pickup characteristic. Its direc- such that it gives about 25 db n to noise coming from behind oured pickup area.

other miniature types are avail- he KM-53 having omnidirectional eristics and the KM-56 omni- nal, cardiod or bidirectional char- ics selectable by turning a ring.

It is interesting to note that a Neumann type 49 microphone is available which is arranged so that the directional characteristics can be changed by remote control from an operating position.

In common with all condenser microphones, the output from the microphone proper is extremely low and of an impedance such that it cannot be transmitted by cable over any appreciable distance. To overcome this difficulty, the Neumann microphones have a valve amplifier and output transformer built into the microphone housing. The output impedance from the transformer is 200 or 50 ohms.

NE FILTERS FOR BROADCAST AND T.V.

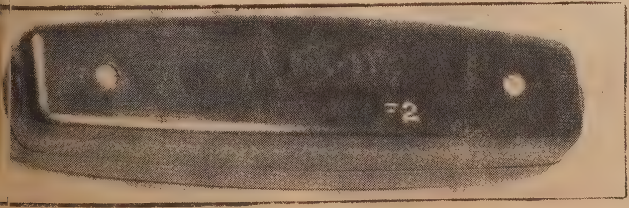
amount of radio equipment in use is ever on the increase and its ulness and reliability depends on interference free channels. Television eivers and VHF communication equipment are particularly vulnerable, not to mention normal broadcast receivers.

interference originates from all electric motors such as are sewing machines, vacuum clean- egg-beaters, while vibrator-type razors can also be serious rs.

es Manufacturing Co. Pty. Ltd., of ittle Lonsdale Street, Melbourne, ade available the power lead filter ted here, which is intended to be in the main power lead close to the offending device.

Two versions of the filter are available, both in the same moulding. The first contains a special balanced capacitor only, and is intended for use on the broadcast band. The second is intended mainly for T.V. work.

Current through the broadcast unit should not exceed 5 amperes, while the TV filter is rated to carry 2 amperes only.



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OFF THE RECORD — NEWS & REVIEWS

Last year, when in England, I met Mr. Arnold Sugden, maker of the Connoisseur pick-up motors, and audio equipment, and heard demonstrations of his stereophonic records. Thes records are cut with a groove modulated both laterally and vertically, so that, when playe back with a dual pick-up, two channels become available from a single disc.

THE records I heard were experimental acetates, and the play-back head was not a production type, but the results were quite encouraging.

Now I have news that he has prepared some regular pressings, and it is obvious that he has carried his work considerably further.

In discussions last year, he made it plain that he intended eventually to offer equipment and records for sale using this new principle — new at least as far as the public is concerned.

As far as I know, he will be the first man to do it, if by this time his plans are sufficiently advanced.

Apart from a private hearing at the factory (which is within a good, strong stone's throw of the Wharfedale Works at Bradford) I heard his records at the British Sound Recording Society's yearly exhibition, at which the first public demonstration was given.

APPRECIABLE SEPARATION

There was little doubt that appreciable separation of the two channels was possible, and despite the experimental nature of the records and equipment, the sound was remarkably good.

The second London Audio Fair which took place at the Waldorf Hotel in May of this year included another demonstration using the latest processed discs, and I have no doubt they would prove much more satisfactory than the earlier efforts.

Reports are that the demonstration was one of the Fair's highlights, and interested more people than just the general public for whom it was intended.

Sugden claims that he is able to accommodate frequencies up to 12 Kc., and achieve a channel separation of 25 db., which should be good enough for realistic results.

The reports I have indicated that the possibility of this type of disc making an appearance on a wider scale seem to be brighter than last year.

All the big record companies I spoke to at that time admitted having experimented with the system, but it was equally obvious that they hesitated to go any further for reasons which might have been as much commercial as they were technical.

MANY DIFFICULTIES

I had the impression that, if someone was game enough to take a plunge with a satisfactory disc, others would follow.

There are many difficulties inseparable with the proposition. Technically it may yet have to be proved that tracing distortion can be kept to an acceptable figure using a groove that has to do so much. It is almost impossible to estimate how serious that distortion would be, and, of course, no one has published any figures about it.

Each equipment would require a special pick-up head with a stylus which operated two movements, one at right angles to the other. This immediately suggests very great problems if the mass of moving parts is to be kept low, and the compliance of the system high. It is likely to be more than twice as difficult as for a single head pickup.

I have no details of how Sugden has tackled this problem, but the pickup he was using last year was merely a hand-made device prepared for the occasion using two standard crystal movements.

SO FAR WITH TAPE

So far, all the big companies have preferred to make their twin-channel bow with the use of tape, which initially has no new technical problems, merely the necessity of doubling up on reproducing channels. It risks very little money as compared to launching a campaign on a new type of gramophone record which cannot be played as intended with a standard pickup.

But once the initial step is taken, there could be a future for a disc.

A big attraction of a binaural disc is that it does not depart from the familiar process of placing a record on a turntable and a stylus in a groove.

This is a process as familiar to us as is tuning a radio set.

Tape's big disadvantage for the man in the street is that it is a completely unfamiliar method of playback. And it's still far messier than a neat and attractively packaged record, although plastic tape cassettes have been made which could overcome this objection.

Whereas the lateral-vertical disc might even be made "compatible" — that is, able to be played with an ordinary pickup which would reproduce the lateral groove only.

If, as some people now maintain, it is only necessary to carry the upper frequencies on the second channel to obtain satisfactory binaural effects, the vertical channel would not even be called upon to acccommodate the full frequency range, probably a big factor in keeping intermodulation and distortion low.

The key to the whole problem seems to be this — will enough people think the stereo feature sufficiently worthwhile to install the necessary amplifiers and speakers?

by John Moyle

It is certain that some enthusiasts but what about the average man?

In most things, we reach an opt in performance beyond which onl dedicated will want to go.

It may well be that the present standard of the single channel recor reached that optimum.

If so, then the future for any system will lie in a specialised m the returns from which will not con with those from the main bulk o record business.

Someone will have to take a ri find out.

So far, there isn't much room fo couragement in the response to tapes. On a percentage basis, they been slow sellers.

At the same time there is some sufficiently fascinating in the possi of the stereo type disc to make it watching.

Meanwhile I had my own sha shocks during the month.

PICKUP TESTS

For some time I have been w for a chance to make some tests on ups, and to run them through with I brought back from the States co ing some excellent square wave an termodulation test grooves.

For some time I have been plu the use of recorded square waves basis for testing amplifier system

It seemed only half the story t amplifiers with very severe square and to condemn them for ringing. there was no evidence that they ever receive such steep-sided forms from a disc.

On the other hand, I wanted to what kind of a fist modern reco equipment would make of cutti square wave at 5 Kc., the frequ most favoured for amplifier testin least with me), and what would b chances of playing it back with eve best of pick-ups.

SQUARE WAVES

The highest square-wave freq on my test record is 1 Kc., and I a pated that, for a decent pick-up would be a piece of cake.

So I assembled a collection of Two were moving-coil types of hig putation, and two were movin types almost equally well thought

Maybe you are way ahead of me

All four pick-ups produced straight sides to their patterns.

But only one produced even a proximation of a straight line alon top!

Both the moving-coil pick-ups lovely examples of ringing. The quality type overshot by about 5 cent., and its oscillations had not c before the end of the flat top was t was, however, obviously ringing one frequency, and later tests l that it had grown a peak at about . since first put into use, prob- lue to relaxation of the damping al used in the movement.

wave-form. however. was very

only fair to say that this pick-up, new condition, and without the grown peak, would probably have a good result. Extra weight on the which applied extra damping from cord groove, greatly reduced the ude of the ringing, which was now hed altogether over the last half flat top.

onsideration for the record grooves, 't persist very long with this prac-

moving iron pick-up, which did f the four, showed continuous ring- low amplitude over the full flat ut its irregular shape suggested that l frequencies were involved.

s was later verified with a normal ncy check which revealed notice- wave-form distortion at various in its response.

HIS TYPICAL?

time permitted, it would have most instructive to have run full ise curves of all four pick-ups and ared results, but I was so shaken just sat down to think it over.

his experience typical of the pick- e are using, even the best of them, is I very unlucky?

bably a bit of each is the truth, does seem highly probable that of us who fondly imagine that the and purchase price of a pick-up guaranteed us perfection are de- ourselves, particularly if the pick- re more than about 12 months old.

without doubt, a good pick-up d be able to trace a 1 Kc. square quite well, particularly when we nber that it came from a disc which one through normal recording and ssing cycles, and was not artificially ced by test equipment as are the e waves used for amplifier testing.

d certainly it should not exhibit sive ringing, as did some of those I tested.

PECTED PEAK

nust say that the results with the up with the peak were not alto- r unexpected, as I had originally the check because I had begun to ct it of having an edge which was here when new, and it has had a hard life under my hands.

at did shock me was to find that it deteriorated to such an extent.

d if this happens to an unques- bly well designed pick-up, what on must happen with a poor one?

r that matter, how many recording eers know what happens to their ng heads when smacked with a rise equivalent to that of a square wave?

have asked that question in many ous recording studios of the world. never yet seen an answer.

e answer would be, very simply, a grooves cut with a square wave at

we had something like this to around with, maybe we could get rst base in our efforts to get off the is what can be put on to it.

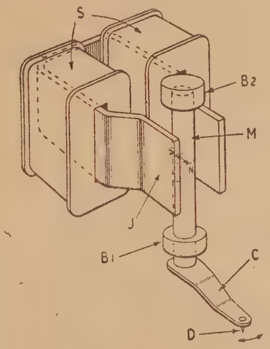
Referring again to the British Audio Fair, a recent Wireless World showed a working drawing of a new pickup cartridge made by Philips which appears to have great possibilities I saw one of these cartridges in Holland last year but they were not then ready for production

MOVING MAGNET

The interesting part about this pickup is that the moving armature is actually the magnet in the system. and its vertical suspension and cantilever stylus mount give it a number of advantages at present enjoyed only by certain moving-coil types

The design has been made possible by the use of the lightweight, high coercive, material Ferroxdure, which. when in cylindrical form as in this application. can be magnetised in a direction at right angles to the cylinder axis.

In the schematic illustration of the pickup shown, lateral movement of the stylus D is converted by means of the cantilever C and the bearings B1, B2 into angular movement of the Ferroxdure magnet M. This induces an e.m.f. in the coils S wound on the magnetic material J in whose gap the magnet lies.



Section drawing of the new Philips pickup.

In this design the effective mass at the stylus tip is 3 mgm. the lateral compliance extremely high and the output 4mV per cm/sec recorded velocity The frequency response is flat from 30 c/s to 15 kc/s, the high-frequency resonance being at about 25 kc/s on vinyl discs.

Altogether this looks to be a most interesting pickup, and its appearance in Australia should be a popular one. At the moment I do not know when this is likely to be. although there are rumours that a complete player unit will soon be available here.

RECORD REVIEWS

VAUGHAN WILLIAMS — Romance for Harmonica with Strings and Pianoforte. Played by Larry Adler and conducted by Sir Malcolm Sargent.

ARTHUR BENJAMIN — Concerto for Harmonica and Orchestra played by Larry Adler and the London Symphony Orchestra conducted by Basil Cameron. Columbia 330S 1023.

Not the least intriguing thing about

These previously hard-to-get
HIGH FIDELITY RECORDS
are now available at your favourite record bar.

HIFIRECORD

R-201: JOE ENOS PLAYS TWO PIANOS: Malaguena (Lecuona The Butterfly (Grieg). Prelude in G Minor (Rachmaninoff): Among My Souvenirs (Nicholls) Rondo Capriccioso (Mendelssohn) Bess You, Is My Woman (Gershwin Flight of the Bumble Bee (Rimsky Korsakoff — arr. by Rachmaninoff) Lamento Gitanno (Grever) Jesusita en Chihuahua (Folk Music): The Beautiful Blue Danube (Johann Strauss): The Schulz-Evler "Concert Arabesque": with two piano paraphrasing by Mr. Enos

R-401: DICK STEWART SINGS— Alone Together: Walkin by the River: Ritual Fire Dance (instrumental): It All Depends on You: On a Little Street in Singapore: At Long Last Love: Time Was; Baia (Instrumental); Falling Leaves: The Glory of Love

R-602: HARRY ZIMMERMAN'S BAND WITH A BEA— Sentimental Journey On Wisconsin: Night Train: Alexander's Ragtime Band: I Love a Parade: The Breeze and I: Washington Post March: St. Louis Blues Washington & Lee Swing: Bugle Boy March (a Zimmerman Original).

nixa

VLP-423: ERNEST BLOCH: ISRAEL SYMPHONY Franz Litschauer conducting the Vienna State Opera Orchestra and Soloists of the Akademie Choir (sung in English)

Vanguard

PVL-7001: PROKOFIEV: CANTATA. OP. 78— ALEXANDER NEVSKY Mario Rossi conducting the Vienna State Opera Orchestra and Chorus. Ana Maria Iriarte, mezzo-soprano Russia Under the Mongolian Yoke Song about Alexander Nevsky; The Crusaders in Pskov: The Battle on the Ice: Field of the Dead Alexander's Entry in Pskov

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this record is that the darn thing grows on you!

Most people who have tried to play the mouth-organ in their early youth became aware of a race of those able to do magical things with it far beyond the simple process of suck-blow-suck-blow.

It was an accomplishment which never failed to arouse my admiration.

Larry Adler has for years been a star of the musical hall with his amazing art and showmanship, but this is the first occasion I have ever heard music by two such distinguished composers seriously put together for him.

Both composers have shown that they appreciate all these facets of the mouth organ's armory.

The Vaughan Williams is well named a Romance — it is almost rhapsodical in its small way and very pleasant to hear.

Benjamin is more ingenious and enterprising in his exploration of the mouth organ, for quite obviously this is his main object. Nevertheless is it bright, neat and pointed music, the romantic second movement being much quieter than Vaughan Williams and in its way just as effective.

The recording is very good, and it is obvious that the microphone has allowed Adler to greatly increase his dynamic range over that which he could command in a concert hall. Long experience with mikes has undoubtedly made him a very skilful user of the same.

OUT OF THIS WORLD — A record of Earthquake and Ionospheric Noises recorded by Emory Cook. Long Play 5012.

This is a most extraordinary disc for those with a scientific turn of mind, or who like the unusual.

One side of it is devoted to recordings of earthquakes in various parts of the world, as recorded at the California Institute of Technology on a tape recording seismometer.

Because the frequency of the earth movements is so slow, most of these recordings are played 750 times original speed, at which most of them come through with the impact of thunderclaps.

Even so, some extremely low frequencies are included which make it a fascinating record to reproduce. Cook claims some sounds as low as 10 cycles per second.

One band records a movement too low in pitch to be heard, and with such recording amplitude that few pick-ups will stay in the groove. It is included so that you may watch your pick-up head describing a movement which, althou speeded up, is virtually the same as th originally recorded by the machine California.

Some of the quakes occurred as f away as Hawaii, some in Mexico.

The reverse side is made up of ion spheric noises in the form of bon swishes, whistles, tweeks, wanderi whistles and a variety of combinatio and derivatives, all of which represe the impingement of particle energy up the ionosphere.

Many of these sounds, which can received directly by a specially filter audio system connected to a long aeri are accounted for, but many others, cluding the "Dawn Chorus" of sour which is greatest just before sunrise, still enigmas, the unravelling of whi may lead to profound discoveries abo what goes on in outer space.

FRANCK — Symphony in D minor. Played by the Hague Philharmonic Orchestra conducted by Willem van Otterloo. Philips S 04011 L.

For those who do not like this sy phony played with high colour and lu sonics, this performance will be in mu to their ears.

It doesn't take many drooling perfor ances to put you off it for life.

Van Otterloo, probably one of th who revolt against the purple treatme has produced an extremely well te pered and intelligent version, not at lacking in shape or sensibility, but co pletely free from any hint of exagg ation or affectation.

His tempos are faster than usual, he does not hurry. He has simply deci that the music will not be allowed drag, and it never does.

The recording is not particularly f ward or brilliant, but it is well balan and with a satisfying concert hall atm phere. It is also very quiet and cle there is a relaxed air about it which w suits a very creditable effort.

If I were to select a performance m likely to please most people, this mi well be it.

SIBELIUS—Symphony No. 2 in D Major. Played by the Philadel phia Orchestra, conducted by Eugene Ormandy. Coronet KLC586

There are many differences betw this version and that of Anthony C lins, for instance.

Some of them are unexpected.

I was prepared to find the outlo much less arctic than Decca's record, the Philadelphia doesn't operate too w at low temperatures.

I wasn't surprised, therefore, to f the music treated to many lusci moments.

But I was disappointed to find th in the process, its shape and progress have been largely mislaid.

Frequently it becomes quite lumpy disjointed, and the import of m phrases and modulations is not r ised.

Collins, on the contrary, although does posture a little, is never in doubt about what he wants, and he it with a sharp clear line that is v rarely achieved by Ormandy.

The sound is much the same as of recent Philadelphia records, wh is a compliment, but it doesn't carr great deal of impact.

But, as I have mentioned previou the competition in Sibelius is really

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ARAJAN'S CHORAL IS IMPRESSIVE

ETHOVEN—Symphony No. 9 Minor; Symphony No. 8 in F r. Played by the Philharmonia stra, conducted by Herbert Karajan, with Elisabeth artzkopf, Marga Hoffgen, Ernst nger, Otto Endelman and the us of the Gesellschaft der kfreunde, Vienna. Columbia X 1391/2.

playing a recording of the Ninth s have a feeling of disappointo matter how good it is.

e listened carefully to every ver- released — some of them many - and each time I have tried to why I have not been happy.

of it is probably due to record- ditions.

this new one, for instance.

diately I notice it does not sound usual Philharmonia, for the best ons—it isn't playing in its accus- place.

orchestra is to sound the same all movements, it must be set hall large enough to accommo- the performers.

ingenuity has not yet achieved g acoustics which are magically for the orchestra alone, for or- plus choir, and for both with solo- d to transport successfully the to an ordinary room.

ely admit that fewer jobs could e difficult. Moreover there are of the choral part which are impossible to sing well, much record.

I have never yet heard a a performance in which the sopranos could cope with their part. Or one in which the soloists did not at some time appear to lose touch with each other.

It may, therefore, be more profitable to consider this new performance on a purely comparative basis, by which it comes out very well. More things go right with it, and fewer things go wrong.

Orchestral balance is one of its good points. The strings are rather prominent, but I used the N.A.B. setting, which improved things all round.

Karajan's tempos are fairly standard. In outlook he isn't as majestic as Toscanini, as meticulous as Scherchen, or as passionate as Furtwangler.

He has missed the full fire of the Scherzo (the drum beats are not taut nor the touch brisk enough) the slow movement is sometimes unimaginative, and joy of the final bars is rather mechanical.

The sopranos have been kept well in the background. This has reduced the shrieks but has given the choir an unusual quality. The soloists are all good and combine better than most.

Thus on nearly every count, these records do better than their opposite numbers, and for this reason alone it would be hard to deny it first place among the Ninths.

It plays cleanly and has a good surface.

The Eighth, which fills the fourth side, isn't particularly good, and is something of an anti-climax.

REAT POWER IN COLUMBIA'S AIDA

RDI—Aida with Maria Meneghini Callas, Fedor Barbieri, Rich- d Tucker, Tito Gobbi, Giuseppe esti, Nicola Zaccaria, Franco cardi and Elvira Galassi, Orera and Chorus of La Scala, n, conducted by Tullio Serafin. ombia 33-OCX-1319/20.

ll operas, Aida has a special kind er — something mixed up with gnificence of the setting and the ess of its drama.

e is nothing complicated about ry; there are no tricks of Fate, t is difficult to accept, or miracu- aracters who solve their problems ue of unearthly powers.

nterest lies almost entirely on the y of characters, one upon the r their reactions to circumstances e bludgeoning of Fate.

melodramatic, without a doubt, is the kind of melodrama which, able hands, rises to the level of rama; a little unreal with the in- ing colour of an ancient time. nvincing for all that. We never eason to doubt that it could have ed.

er the stimulus of a stage setting. ready to swear that, in fact, it

o make a successful recording, the impact is through the ear strong personalities and highly d sound are necessary, and the e of both is primarily why these cords are a success.

cast, in fact, must be about as s one could assemble for the job, each character being a recognised performer in the appropriate role.

As with most recorded operas of this series, Aida is built round Madame Callas, and it is inevitable, therefore, that much of your reaction will depend upon whether you like her controversial voice.

There is little doubt about her power to dominate the disc when she is on, either through the extraordinary effects she produces throughout her great range, or through her own vitality.

One has the feeling that her colleagues are giving an extra effort to make sure they are not over sung.

And there is little doubt she makes a deeply moved and passionate Aida, filled with dignity even through her distress, and so possessed with her character that she is unwilling to admit any limits to her resources.

In fact, the tendency to sing themselves out is a characteristic of all the major actors.

Very close miking has been rather deadly in exposing some roughness and vocal defects on Callas, Tucker, and Barbieri, but this is a small penalty to pay in exchange for such a telling performance.

I thought the honours were shared fairly evenly between these three, the latter being a very fine and well drawn Amneris.

But all the cast is good—orchestra and chorus as well.

If I could have removed some of the strange changes of voice by Callas (and a couple of her top notes!) and infused more of the genuine ring into the some-

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sky tones of Tucker, I'd be will- wager this Aida would be tops ong time.

is, I thought it vigourous, musi- nified, its drama well sustained th an acceptable if not striking from mike self-consciousness.

engineering is clean, with some ing high spots, and the sound is d round. Surface noise little han the faintest rustle.

ether, one of the most success- peratic sets.

ITAR SOLO — Music from oven, Schumann, Chopin, De- , Massenet, Grieg and Sor. d by guitarist Laurindo ida. Capitol P-8341.

rding — very good, indeed. A amount of mechanical noise through which is pretty hard to hen recording a plucked instru- close quarters.

guitar is very good material for d of work, and produces particu- alistic results.

cally its success depends upon how y you regard the matter.

items have been drastically al- the process of transposition for tar, and naturally, it is difficult such a wide variety of music nstrument whose very individual- ows an air of sameness.

executant, also, either prefers to ost of them slowly, or is unable with a higher speed.

n only say, therefore, that they nerally pleasant to hear, but no ite for the original.

the classicists of the guitar will ppointed.

ELIBES—Sylvia Ballet Suite; pelia Ballet Suite.
OUNOD—Faust Ballet Music. ed by L'Orchestre des Concerts oureux and L'Orchestra du tre Nationale de L'Opera, Paris. lucted by Jean Fournet. Philips 013L.

another Sylvia and Coppelia, and with a French orchestra.

advantage over its contemporaries it adds to these the Faust ballet

ch makes a great deal of ballet on e disc.

are brightly played, and not much to have been sacrificed to get so on the record.

ainly the top registers have not d — the triangles and other jingly nents can be heard with more than e clarity.

amic range may be down a little, ly once did I catch a suggestion of echo.

nice disc, and a very good buy lity and quantity.

CHAIKOWSKY — Symphony 6 in B minor Opus 74. Played the Leningrad Symphony Orches- conducted by Jewgenil Mrawin- DGG LPM 18334.

exceptional recording this. I think I have ever heard such blaz- nd vital fury as the Leningrad stra achieves in the wild moments first movement.

is mood is essential if the sym- 's dynamic tensions are to sound y should.

No array of other virtues can make up for the lack of it.

That tremendous explosion, so often fluffed by players or timid recording engineers, comes off with the impact of an H-bomb.

Only an orchestra of the highest precision and power could manage an attack so well.

To be super critical, there is a rather prominent echo — not unusual with DGG — which, although effectively concert-hall, does add an overhang which degrades the sharp lines of attack and the quality of quieter passages.

On the other hand it does blend the orchestra spatially, to give an impression of size which goes well with this symphony. It would be rather pointless to err on the other side and deny it enough "air".

A good example of this is found in the third movement, where the flexibility and vitality of the players shows up most impressively. The brass and cymbals, so often allowed to overweight the recording for sheer effect, are held well in check, so that we hear the orchestra playing as one body, without being blasted by one section of it.

The last movement could have exhibited its emotions less coldly in an otherwise tremendously effective performance.

You will note, again, the long time constant of the hall.

You will note, too, the extremely fine brass section, which, all through the exacting demands of the work, is outstanding.

The first movement contains some magnificent trombones.

All-in-all this is a very fine disc — probably the best "Pathetique" available

BEETHOVEN — Concerto No. 5 in E flat major Opus 73. Played by Robert Casadesus and the Philharmonic Symphony Orchestra of New York conducted by Dimitri Mitropolous. Coronet KLC 546.

The Emperor is probably the most popular of all Beethoven's concertos, both on recordings and on the concert platform.

When in London last year I heard it played by different people three times in one week, and there were a number of other performances during my stay which I did not attend.

All were well patronised.

By contrast, one of the last concerts I heard there featured Claudio Arrau playing Bartok, and despite a Tchaikowsky Symphony and the Philharmonic Orchestra it was just about the poorest house I can remember.

Casadesus, better known for his Ravel, makes a much better job of the Emperor than I expected.

It isn't a big performance, in the

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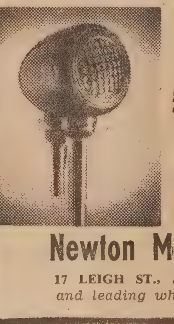

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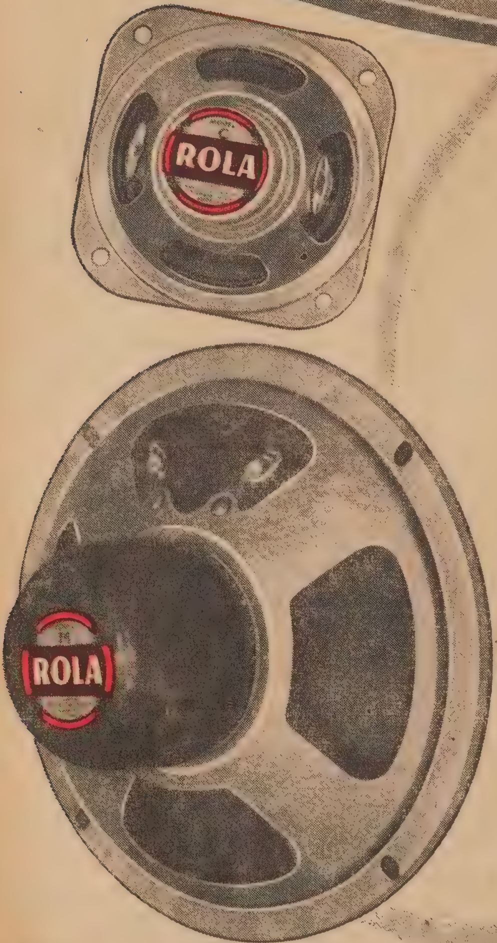

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abe Backhaus or even Kempf man-

arest it comes to full size is in irst movement, but even here it is aight up and down with more nes and pace than subtlety.

th second movement, the pianist es o much to catch the magic that ere nd in the last he gets only part ssible contrast and interplay of

is deft and agile, a fine pianist, g there are times when his touch ong enough for the orchestra, ys robustly throughout.

lly speaking the piano-to- balance is quite good.

cording itself is cut at moderate , rather remote and maybe a t in the bass. The piano is an, and is always pleasant to

t kind of performance which, if not hopelessly addicted to the ter" style, you might easily go

ORAK — Symphony No. 5 in or Opus 95 (New World). by the RIAS Symphony tra, Berlin, conducted by Frisnay. DGG 18142LPM.

st movement comes with a rush citing performance which sets for the whole symphony.

nay not like to hear it in such for its drive (or overdrive) sends g over many passages which are aring more clearly.

h rush at the end, the subject given e brass sounds dangerously like out's band agitato.

ld have liked the conductor to ied a little more here and there, the music could sing as it should.

econd movement is again fairly it Fricsay sees it rather senti- l — he does not aim for that uiet stillness of which it can a lovely example.

third movement you will make note of the effective explosions tympani which are extremely erever heard. This movement. good one to display the strength ght of the players, their fine and the wide dynamic range of rd.

rass, too, is first rate.

last movement continues the progress of the first, and finishes grand old row.

ay that the whole thing bustles o much for me, that its changes and dynamics are too uneven, there isn't as much tuneful as I would like, that's only a opinion.

bright, full-blooded disc, which well in a clean, reverberant way, with plenty of punch, and likely to many. One of DGG's best s of orchestral recording.

OFENBACH—Gaite Parisienne Music (complete). Played by hiladelphia Orchestra conduct- Eugene Ormandy. Cononet 552.

is one of the best Philadelphia I have ever heard.

sound is rich and full, with a resence that never grows oppres-

mic range is very great, all the

more impressive because the surface is almost completely quiet.

Its frequency range is in the hi-fi class, but the tops have been carefully controlled to avoid any shrillness or edge.

The orchestral playing is exceptional; beautifully balanced, flexible and brilliant.

It is scarcely necessary to say much about the colourful music, excerpts from which are always cropping up in light music sessions. Everybody likes it — it has the same immediate appeal as that of a Strauss waltz.

It comes in a most attractive folder with a striking cover design, and much interesting and instructive matter about the ballet.

It rates the five stars.

BEETHOVEN — Sonata No. 23 in F minor Opus 57 (Appassionata); Sonata No. 32 in C minor Opus 111. Played by Julius Katchen Decca LXTA 5187.

The more difficult the music, the better Katchen seems to play.

Here he attempts two famous and most important Beethoven sonatas; the Appassionata from his middle period, the Opus 111 from his last.

It was, in fact, the last big piano work he ever wrote, and perhaps his finest.

We could seriously argue whether the last movement is not the best to be found in all his piano music.

It has a quality all its own. . . sheds the immediate confines of notes and of instruments, and projects what it has to say so directly from mind to mind that technique becomes merely a method and music a medium.

Katchen's Appassionata is a powerful and masterly version, quite free from mawkish exploitation or pedantry.

Its outlines are appropriately massive, its texture is explored with scholarship and interest, it is lively and enterprising without damage to its sincerity.

In the Opus 111, Katchen's vigour and impetuosity are perhaps a little too much in evidence when compared with the more classical performances of Schnabel, Petri and Gieseking. But this is a young man's Beethoven and it is good to hear it. I found his performance profoundly impressive.

The piano recording is good, even in its most forceful passages. Its presence I thought just right, although the tone is rather hard until you get used to it.

This disc would be my first preference for both these sonatas. I class it with the earlier Diabelli variations as some of the best Beethoven on records.

The surface is first rate.

DEBUSSY — La Mer. Played by the Philharmonic Symphony Orchestra of New York conducted by Dimitri Mitropolous.

ROY HARRIS — Symphony No. 7. Played by the Philadelphia Orchestra conducted by Eugene Ormandy. Coronet KLC 561.

La Mer is the most brightly coloured of all the versions I have.

The music is highly programmatic— it was intended to sound like the sea, and it does.

I wonder whether the glorious Technicolor is overdone?

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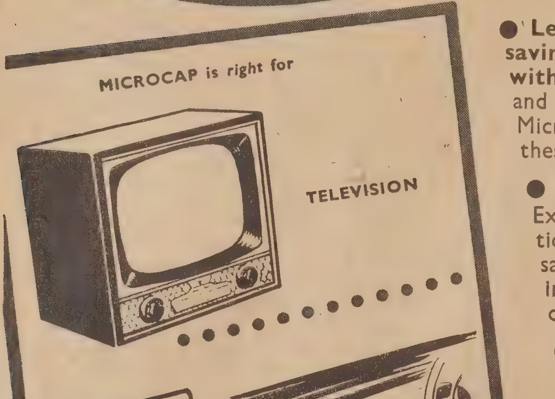
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ni, for instance, does not at- glamourise the scene with as w.

chestra does not snatch at a r invest in so many sudden adventures.

proach has a colder, more to it. He paints clear and ures to be seen and marvelled polous adds 3-D, and warms for audience participation.

nevitable, therefore, that we so often listening to a brilliant or the sweep of strings, or a woodwind. These things are eautiful for Toscanini, but we only if we listen for them; oo much part of the whole to ant of themselves.

are interested in the compari- the last inch of each disc one other.

e, both conductor and orch- well suited to the contrasting of the Harris 7th Symphony.

who remember the first re- f his 3rd will recognise im- much of the same idiom and division that made that sym- h an exciting thing.

lon't know that this one is a k. As it progresses, you might it as more or less a variation ne manner. Its angry noise is g, and the Philadelphians, who d it in 1955, can probably do han anyone else.

DIN — Polovtsian Dances, Steppes of Central Asia.

LITOV-IVANOV — Cau- Sketches. Played by the Phil- ic Symphony Orchestra of ork conducted by Dimitri lous. Coronet KLC 547.

ording is bright — it has good he balance exhibits the orches- advantage, and it is forward be quite brilliant.

well, particularly if you have wer to spare. I'd like more in the Polovstian Dances; they ore like a rough-and-tumble wild things they are.

Steppes" is done well, the re- eing a little too close to allow istant fade-out.

ketches" have a straight for- mencement, rather spoiled on by too much surface noise. rove as they go along, and end t excitement.

record. Plays best with an ch of bass boost, but is com- free from the edge which so ils American discs. RIAA curve.

UMANN — Carnaval Opus antasie in C Major Opus 17. by Robert Casadesus. t KLC 583.

are hard driven versions, on of works which are neither capable of being driven.

aying is crystal clear, deft, and te beautiful.

cs of the Carnaval and the Vari- better for bright treatment, but te of the traditional poetry is e others.

is strange, because the pianist apable of playing them as most r them in our own minds.

approach is through a desire to avoid orthodoxy, then you must judge it on its merits.

But to me it does sound as though Casadesus isn't altogether compatible with Schumann.

The recording shows the piano on the hard side, not too forward, and with ample power.

The surface has some faint crackles which might be a nuisance on wide range gear.

MENDELSSOHN — Violin Concerto in E minor Opus 64.

MAX BRUCH — Violin Concerto in G minor Opus 26. Played by the Pittsburgh Symphony Orchestra conducted by William Steinberg. Capitol P 8243.

Both these concertos suit Milstein. He is a rock steady violinist, with an intonation so good that you notice it, and a firm, fine tone.

He does not often give forth with great power, but neither of these two concertos needs it.

The Max Bruch satisfied me as it rarely does. The orchestra was largely responsible for this, as it shapes the music and handles it with a simple intelligence that keeps our interest.

As the jacket points out, the work is really a second movement with a prelude and a coda fore and aft, and it was the firm manner in which this is emphasised which impressed me.

Milstein's handling of the slow movement is a nice balance between strength and sentiment, with probably fewer affectations than in any other recording.

The Mendelssohn is good, too, although I would have liked more dash in the final movement which diminishes to quite a small stature near the end — small at least in contrast with earlier passages, for there is quite an impressive and virile body of sound on this disc

There are now too many versions to undertake a detailed comparison between them, but Milstein combines most of the good things of the others to produce one which will I am sure be acceptable to all.

Certainly you would have to split the coupling to better either side.

The recording is smooth rather than brilliant. A touch of top cut might take a slight edge from the violin. The surface seems OK.

BRAHMS — Symphony No. 4 in E minor, played by the Philharmonia Orchestra, conducted by Herbert von Karajan. Columbia 330CX 1362.

The first movement is rather slow in starting, but it is a fine disc and a fine performance, improving with each movement until, at the end, everything is first class.

The first movement disappointed me initially. There seemed little enthusiasm from orchestra or conductor. Even with several check-backs, I still think it could have been done again, when all concerned might have been in better mood.

Like most Karajan performances it is free from any extremities or conceits; touched with dignity, brisk but unhurried.

Its the kind of reading most people will like, and which will wear well.

The Philharmonia is, as always, firm and well disciplined. Its sound is full and clean.

There are several very good Fourths, but this one is in the front rank.

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SHORT-WAVE NOTES BY ART CUSHE

RARATONGA HAS MOVED TO 4965Kc

Raratonga Radio in the Cook Islands is at present being heard on the new frequency of 4965 Kc. during the Thursday broadcast.

THE transmissions from the Cook Islands are being heard in New Zealand where the programs from ZK1ZA are being received.

This station has been operating on 5050 Kc. for some months but has recently moved to 4965 Kc. It has a regular transmission on Thursday from 2.30 p.m. and this broadcast generally lasts for one hour. School brodacasts are also released, but these are irregular.

According to a report from the Pacific Island Monthly the Raratonga station broadcasts over the station of the Cook Island Administration. The frequency change was made on May 1.

The transmitter is located at Black Rock on the north west coast of Raratonga Island and program material is all tape-recorded by the Social Development Department, prior to the actual broadcast.

The tapes are handed over to the Radio Department for transmission through a transmitter which is also used on other frequencies for telegraphic communication to overseas at other times.

No funds have yet been made available by the New Zealand Government for the establishment of a proper broadcasting station, but there has been a suggestion, as an interim measure, that a more frequent service might be operated through a privately owned amateur station, the operator of which also has a commercial broadcast licence.

Radio Raratonga has been heard in New Zealand at good strength during the Thursday broadcast from 2.30 p.m. It broadcasts a lengthy list of shipping activities at Raratonga at 3.10 p.m. and this is repeated in the local native tongue. The station closes at 3.15 p.m. when this announcement is given: "Well there we must say goodbye — will be on the same time next Wednesday evening, when we will bring you more information news and entertainment from Raratonga. Until then, goodnight."

An island musical number follows and at 3.15 p.m. the transmitter announcer signs the station off the air with this identification — "This is ZK1ZA Radio Raratonga, owned and operated by the Cook Island Administration. Be listening to this station again next Wednesday."

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R.H.757 .... Age ....

RADIO RANGOON

The new high powered transmitters of the Burma Broadcasting Service at Rangoon, have been heard by listeners in Australasia and the Near East.

This 100,000 watt transmitter, the first of several to operate on both short and medium waves, has been heard on the 11764 Kc. channel carrying the normal Home Service programs from Rangoon. It has been noted on the air from shortly after opening, with a test period at 9.40 p.m., and then with normal programs at 10 p.m. to sign off at 1.15 a.m.

The first portion of the service from 10 p.m. to 12.15 a.m. is in Burmese and the last hours transmission is in English with news at 1 a.m.

The station uses a drum beat interval signal from about 9.40 p.m., and shortly after this, the station has uninterupted light music to 10 p.m. when the normal transmission is commenced.

The program in the English hour generally consists of light music. Interference from the nearby Courier channel of 11765 Kc is the main deterent to excellent reception in this area.

The Rangoon station when closing at 1.15 a.m. gives a program summary of the next days transmissions in English, all of these are carried on the only two frequencies now in use, 11764 Kc. in the 25 metre band, and the medium wave channel of 955 Kc.

The second transmission is 5.15-5.45 p.m., and this includes news at 5.30 p.m.

The news session is generally announced by a male speaker and other announcements by a lady speaker. The program summary at 1.15 a.m. is followed by the sign off with the Burmese National anthem.

XEOJ ON 11860 KC.

FIRST reported by listeners in the United States as being received at 12.30 p.m., a new Mexican station has been identified by us as XEOJ. This station, because of severe side interference from Berne Switzerland, defied identity by American listeners, but a recorded sign off at 4 p.m. was made and we were able to identify the announcement as: "XERJ ondas larga 1320 kilocycles en XEOJ ondas cortas 11860 kilocycles."

The station is operating from Mazatlan in the province of Sinloa, Mexico. The 1320 kilocycles station operates with 1000 watts day and 500 watts night.

DXB3 COTABATO

THE strong signals of the new DXB3 Cotabato, Philippines has been reported by listeners on both sides of the Tasman. This station operates on 3945 Kc. and has been heard from 7.00 p.m. to midnight. The station announces as "This is the Notre Dame Broadcasting Corporation. Radio Mindanao, broadcasting on stations DXMS 880 kilocycles, and DXB3 on 3945 Kc. and broadcasting from Cotabato, Philippines."

The station broadcasts both commercial and Catholic religious programs and carries a program review at 8.25 p.m. and a news bulletin at 10.30 p.m.

NOTES from readers should be sent to Arthur Cushen, 212 Earn Street, Invercargill, N.Z. All times are Eastern Australian.

STATION FOR TONGA

NEARBY Tonga is also soon to have a station, as a member of the New Zealand Broadcasting Service has been investigating the technical facilities necessary at Nukualofa, the capital on Tongatabu Island.

This station has been mooted for several years and would almost certainly use one of the tropical bands, 5000 or 6000 Kc, as favoured by the Island stations. There may be also a medium wave outlet for local coverage.

Tonga and the New Hebrides are the only major groups in the Pacific without a radio service.

FLASHES FROM EVERYWHERE

RADIO GOA in Portuguese India is
stall three new transmitters according to
tuguse Press report, which states that one
watt transmitter will operate on shortwa
two 25,000 watt transmitters on the br
band.

Mexican XEXE on 11900 Kc. is again
but this station, as in common with all the
of the XEX chain are never reported as
in the habit of verifying.

OKINAWA relay station of the Vo
America has been noted on several ne
quencies from opening at 6.30 p.m. wh
station has been using 17830, 15380. 118
9635 Kc.

The station has been observed continuo
these channels to sign off at 2.30 a.m.
Courier transmitter of the Voice of Ame
Salonika has been noted 15165 Kc. instead
listed frequency of 15195 Kc.

ANGOLA station, Radio Club of Lua
Nova Lisbon, has replied to a Cyprus
that the station operates on two freq
and the schedule is 4.00-5.00 p.m., 9.
p.m., and 3.30-7.00 a.m., daily. On Sun
schedule is 4.00-8.00 p.m., and 12.30-4.
on Monday morning. The station is
CR6RQ, 7152 Kc, and CR6RD on 4851

RADIO ZANZIBAR, in the East African
has been heard in the Middle East on t
quencies, 3339 and 4795 from opening t
gram at 4.30 a.m. The lower frequency
the weaker signal when tuned in Cyprus.

VENEZUELAN signals in the 31 metr
are reported by Stuart Morris of Victor
mentions that both YVXJ on 9505 and Y
9530 Kc. both opening at 8.30 p.m. Our
tions here show that YVMZ at Maracaib
the slogan "Radio Popular" is much th
signal. It opens with the Venezuelan anth
then news items interspersed with con
announcements. The YVXJ Radio Baraq
station is mixed both with the Manila an
California stations on nearby channels
much harder to hear, but has a similar
program.

BOLIVIAN station Radio Illimani. The
Bolivia, has been providing good signals
Kc. from opening at 9 p.m. and this st
the only reliable signal from this seldor
country. The station opens with an organ
and the sign on announcement is genera
by a lady announcer, and the program f
is of popular Latin American melodies.

ROUMANIA has added the 19 metre
its North American service, in the progra
Bucharest. The station is using the
quencies of 9570 and 11937 Kc., as well
new 19 metre transmitter on 15373 K
station has news with good strength at
and 2.30 p.m.

BRAZZAVILLE transmissions to the
are being reported on 17879 Kc., from 11
to 1.15 a.m. English programs are fro
to 12.45 a.m., and reports from the
American area state interference is presen
channel from WLWO, on 17880 Kc.,
on the frequency at 1 a.m.

HAITIAN transmissions in the 13 me
have been reported from several areas.
latest report from North America has
the position. The 4VWI transmitter of t
galistic Voice of the West Indies is at Ca
in Haiti. The station is using the 21
21525 Kc. The former transmitter has a
covering Europe and the South Paci
operates on Sunday and Monday 6.00-9
on 21525 Kc., and on Sundays from 8
midnight on 21540 Kc. Reports are req
Box 1, Cap Haitian, Haiti.

AFRS SCHEDULE

THE Armed Forces Radio and Televisio
at Los Angeles, has increased t
schedule to 14 hours, now operating 11.0
a.m. The new schedule has news each ho
when carrying baseball 1.05-3.00 p.m.,and
p.m.

A new transmitting schedule included t
the main A.F.R.S. channels, on a revise
The new schedule is:-

K.C.B.R.-1 (15125) 11.15 a.m.-4.15 p
K.C.B.R.-2 (21630), 11.00 a.m.-5.00 p.
K.C.B.R.-2 (9700), 5.30 p.m.-1.00 a.
K.C.B.R.3 (17850) 11.00 a.m.-5.00 p.
K.C.B.R.3 (11870), 5.30-1.00 a.m.
KCBR-5 (15315), 11.00 a.m.-4.00 p.m.
K.C.B.R.-5 (9570), 4.30-10.00 p.m.
K.C.B.R.-5 (15315) 10.15 p.m.-1.00

**The program which gives the informat
program and schedule changes is released
as 11.15 a.m. and 5.45 p.m.; while on th
15th of each month a program giving the
program content for each day and the f
in operation is carried by A.F.R.T.S.**

E HAM BANDS WITH BILL MOORE

ficial station of the N.S.W. Division of the WIA, VK2WI, will be able to perform a ble service to amateur radio by disseminating news and to the public in emergency from the new site and with its higher powered transmitters.

R event in Amateur Radio history in took place in May with the official the VK2WI transmitter house and site ister of the Interior, Mr. Allan Fair-

persons attended the largest gathering teurs and their families yet assembled te.

WIA president Jim Corbin, VK2YC, he guests and visitors on behalf of the d outlined the objects that led to the f the site and the building of the house.

erve a threefold purpose according to nt — to disseminate WIA news, as tation for work in emergency and as to Civil Defence communication.

lned that the erection had been carried nteer effort of members and had been om Institute funds and from donations ted to over £1,000.

introduced the Minister. Mr. Allan M.H.R., VK2KB, whose opening re- hasised the value of the movement to nity in peace and war.

ister mentioned radio amateurs' work ng the high frequencies and referred to their record in World War II.

AF RESERVE

specifically was the amateur's Vireless Reserve, whose members were immediately on the outbreak of the ovided a valuable addition to the sig-

rhall also mentioned the work of emergency during flood and bushfire reference to the assistance rendered State-wide floods of 1956, he said that rs on the North Coast of N.S.W. had fine record of public service.

ister said that amateurs would have organised to meet the demands that to be made on their exclusive fre- other services. He suggested that hould fully support the WIA and so tive representation in official circles.

nall then declared the VK2WI building pen.

uperintendent Wal Salmon, VK2SA, on the value of the hobby as a train- for youths and some of the prob- venile deliquency.

ibed too the earlier work on N.S.W. ireless organisation carried out by an interesting summary of the original

eakers included Mr. Robertson, Deputy of Civil Defence in N.S.W. who cover- ssible work of amateurs in CD com- and Colonel Lawrence of Army Sig- ird out the invaluable work of amateur ions in the first stages of any emer-

so present were Mr. Allan Grant, C.D. nitions Co-ordinator for N.S.W., W./C. ome Command, R.A.A.F., Penrith, Sgt. ock, VK2ZI, Officer in Charge Police d Mr. Lionel Todd, VK2LS, represent- perintendent, Wireless, N.S.W.

timers of World War I vintage seen notes were Chas Maclurcan, VK2CM, Joe Reed, VK2JR, Jack Pike, VK2JP, Wal Hannam, VK2AXH, and a previous secretary of the Division' Malcolm Perry.

Two country amateurs who travelled the longest distance to be present were John Field, VK2AQF, of Deniliquin and his wife and Rod Pike, VK2ACU, of Coonamble.

Many amateurs and associates contributed toward the VK2WI home, either by contributions or voluntary labour, or both.

On the opening day councillors and members worked hard to ensure that visitors were suitably entertained but all will agree that Harry Pickett, VK2AHP, Ed Hulme, VK2EN, and Engineer Dave Duff, VK2EO, should be congratulated for their efforts.

OPENING BROADCAST

The whole of the opening ceremony was rebroadcast by VK2WI on 7146 Kc/s and was of particular interest to country members. The net organisation of VK2WI was demonstrated to the guests when stations throughout N.S.W. answered spot calls. Full co-operation was accorded by all country amateurs.

The Minister also spoke over VK2WI and at the conclusion of the ceremony afternoon tea was served.

The VK2WI transmitters are located on a 5 acre block 700 feet above sea level at Dural, 20 miles north-west of Sydney. The building comprises two large rooms. One houses the transmitting and receiving equipment, and the other is suitable for entertaining complete with built-in table, and running water. The transmitting equipment is impressive and covers all bands 3.5 mc/s through 144 mc/s.

The main transmission is radiated on 7 mc/s and on this band an AT14 — parallel 813's running 450 watts input to a half wave dipole fed with co-axial cable is used. A similar antenna is operated on 3.5 mc/s where the transmitter runs push-pull 807's.

FINAL AMPLIFIERS

In the transmitters 14 mc/s to 56 mc/s the finals range from push-pull 813's to 829's on 28 and 56 mc/s. The last three bands are not used currently and the third transmission normally takes place on 144 mc/s where an 829 running 85 watts feeds a four stack turnstile.

This antenna is nearly 70 feet high fed with a 300 ohm ribbon and coverage up to 180 miles has been recorded. At the moment the receiver for the HF bands is an AR7.

The major problem experienced to date during operation is varying mains voltage, at times as low as 90 volts, and a variac allows transmission only on occasions. The local supply authorities have promised to improve the available voltage.

With the completion of all tests VK2WI will certainly be able to effectively cover N.S.W. during any operation.

W DX AWARD BASED ON AMATEUR PREFIXES

ely new type of D.X. operating award een instituted by the C.Q. Magazine. It X. (worked all prefixes) award and is o licenced amateurs throughout the have made radio contacts with 300 or ent radio "prefixes".

for the purposes of the award is the ree letter/numeral combination which first part of any amateur call."

ple W2, K2, KN2, 5A1, 5A2, DJ1 and all be considered different.

no question of countries and the con- question of what should constitute a al what should not is bypassed. VP8 a oring some recognised countries would as one prefix for the purposes of the

s for the W.P.X. must submit a list call-signs of the stations worked follow- date of the contact and must be in pos- he Q.S.L. cards or other proof of con- submitting the list. C.Q. reserves examine all Q.S.L. cards.

cts must have taken place since January

on to the basic awards for working 300 ckers will be available for one band n all 8 basic awards will be available, W.P.X.-phone, W.P.X.-C.W., W.P.X.-S.S.B., W.P.X.-M. (mobile), W.P.X.-A.M. (aero-nautical mobile), W.P.X.-M.M. (maritime mobile), W.P.X.-T.S. (transistor Q.S.O.'s).

VP8AP should be operating as VP8SP from Cargados Carajos a dependency about 250 miles N.N.E. of Mauritius in August. He will run approximately 12 watts input on the 14 mc/s band. This one could easily be rated a new country.

The following procedure has been suggested as the most effective manner to ensure Q.S.L. cards arriving at their destination in the U.S.S.R. A well known U.A.3 offered the suggestion. On receiving a Q.S.L. card from U stations forward the card direct to the address shown thereon.

If sending cards via Box 88 Moscow, do not show callsigns or other radio data on the envelope, just the address as above.

Currently in the news is the unfortunate floundering during rescue operations of the "Tahiti Nui" the raft that by design was drifting from the Pacific Islands to the coast of South America.

Operators from the raft using the call FO8AP/MM have been quite active on both the 14 and 28 mc bands. 16 I.R.C.s are sufficient to obtain a three colour map of the expeditions' route and other features of the trip. Address requests to F8TM Rex BP42.01, Paris, R.P., France.

Propagation research

THE A.R.R.L.-I.G.Y. Propagation Research Project started off on schedule last September. The special A.R.R.L. staff engaged is paid under contract to the Department of the Air and will continue to be employed by that Department for the duration of the Geophysical Year, concluding at the end of 1958, or for a longer period if the investigations require it.

Over 800 amateurs in all parts of the world have already signified their intention of participating.

These amateurs have been requested to forward reports twice monthly, a list of stations worked and heard via ionospheric propagation modes on the bands over 50 mc/s. They are asked also to report times of operating or listening with no results. These are known as positive and negative reports respectively.

The main types of propagation on which information is required are trans-equatorial scatter, long North-South Contacts, paths crossing the equator especially with openings at the "wrong time."

Sporadic E skip, Auroral and meteor scatter and news of F2 openings are also required for conventional skip and back scatter variety. All these modes of propagation involve the ionosphere and most of their uses for practical communication were found by radio amateurs.

The project runs its own publication for issue to registered observers and is now used mainly for instructional purposes but later news of VHF activity and reports sent in from the various observers will be included.

READY FOR JULY 1

The trial run on observations commenced on January 1 and the whole scheme should be in full force by the time of the opening on July 1 of the Geophysical Year.

As each report is received it will be inspected and evaluated, and additional information such as latitude and longitude of the station added. Reports will then be sent to an operator who will prepare punched cards showing all pertinent information. The process will list all data received for high speed automatic sorting and summarising at a later date.

It is anticipated that the peak periods for I.G.Y. activity by radio amateurs should be in the periods of October and November this year and January and February of 1958.

In the U.K. the Radio Society of Great Britain has appointed two co-ordinators for I.G.Y.-D.W. Turby, G3EOH, and G.M.C. Stone, G3FZL. It is proposed to name Area Activity Co-ordinators whose responsibility it will be to organise particular areas and assure that the different study aspects are covered. The general plan is still in the embryo stage.

Locally amateurs are already active with the I.G.Y. project in co-operation with the Sydney Amateur Astronomers for whom they will make radio observations on the track of the world satellites, one phase of I.G.Y. amateur working.

Four converters have been constructed and they will be located in country and city areas. Hugo Stitt, VK2WH, Forbes, and Neville Wilde, VK2DR, Blayney, will be the country observers with John Miller, VK2ANF, and Bob Godsall, VK2ARG, in Sydney. They expect to use four element yagi arrays for receiving.

CO-ORDINATOR IS VK2HO

Roy Hart, VK2HO (recently returned from the Civil Defence School at Macedon) will be the co-ordinator and he will report satellite progress from the four stations to the observing post of the amateur astronomers at Belfields, Sydney.

At this post Harry Lapthorne, VK2HL, assisted by other amateurs, will assure that the warnings are received from VK2HO and broadcast over loudspeakers to the observers ready to train their telescopes on the satellite.

The whole object of the scheme is to provide some warning of the satellite's approach to the amateur astronomers.

The antennas of the listening post stations will be facing west and as soon as the satellite comes over the horizon they will transmit a warning via the net. It is expected by this means that about one minute warnings of the satellite's approach will be given.

Project Vanguard, the official name of the operation will commence when a 72 foot high rocket will be launched at Cape Canaveral, Florida. Out of the rockets nose the satellite, a magnesium sphere, will be ejected by a charge at the correct height.

The estimated time the satellite, 20in in diameter and 21.5 pounds in weight will remain in orbit varies greatly, but it will circle the earth every 90 minutes.

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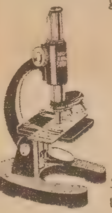

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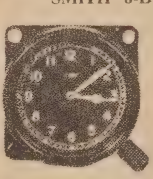

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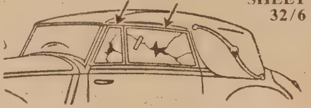

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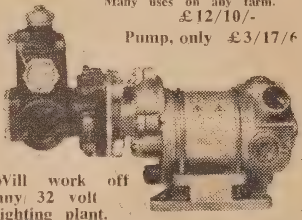

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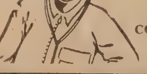

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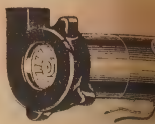

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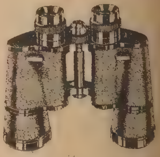

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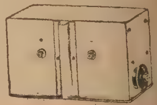

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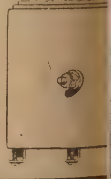

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eal of important information will be tape and as the satellite passes around pecial stations, authorised to interro-end up signals which will trigger off er to radiate the recorded information h. During this transmission the circuit open for 30 seconds.

mpletion of this special broadcast the ill revert to low power to preserve bat- These transmissions will be strong acking purposes. The transmitter using crystal controlled and will run 15 itput during the tracking transmissions

TIONS ON 144 MC

nc/s band provided some good condi- late May when Ian Berwick, VK3ALZ, e and Hugh Stitt, VK2WH, exchanged he band over 350 miles. Jim Edge, ho was at Forbes at the time bears ie fact. Previously Hugo had identi- from VK5BC, and VK5MT portable he first time signals from South Aus- been heard in N.S.W. The distance is proximately.

recht, VK2RS, is currently testing out na for 144 mc, a five element Quad.

stations finally made contact to South- on the 50 mc/s band in March. The e well known stations ZE2JE Southern VQ2PL Northern Rhodesia and they umber of W stations.

same period, against all recorded pre- band opened to South America with LU, OA and PZ being contacted.

COMMERCIAL NTERFERENCE

methods of reporting upon and acting the ever increasing number of commer- adcasting stations operating within our ds have been suggested. Some time ago proposed to the British G.P.O. that roup of members should be permitted of the G.P.O. monitoring stations by herever a spasmodic broadcasting or "intruder" is heard in the exclusive ds.

y felt that this method would enable ice to take effective action by report- to the I.F.R.B in Geneva immedi-

). feels that the proposal would not benefit and explained that there is a iculty due firstly to the fact that the ation might not be audible at the ocation and that of the monitoring

hat amateur stations being specifically reception in a limited band and are ve than the Post Office Monitoring hat particular band.

Office points out that the majority of nce which the Society complains about abroad and the only action that they to register a complaint about it.

Office have therefore suggested that the ld contribute more effectively to the of the amateur bands by concentrating ness of information rather than on mmunicating with the Post Office. The ill act only on reports of continuous rather than sporadic cases.

cil have decided to invite members to plete logs of interference that continues weeks, a similar system to that re- here in Australia.

st problem confronting amateurs that ypes of reports is the indentification of ed, broadcasting stations excepted. The enerally heard are from automatic code seldom transmit their calls.

k of value to the movement but few pear to have time available for station

V.H.F. NEWS

den Transmitter searches of the N.S.W. F and T.V. section Eric Dickson, as the only station to locate the trans- e usual "Hot Dogs" and Tea were e remainder when they finally were .

y event saw Bob Winch, VK2OA, and ng, VK2ZBD, tie in a progressive

n will make special preparations to litions on the 144 mc/s band to Vic- uth Australia between July 16 and 31. shower is predicted between those l country V.H.F. amateurs have been e fact. Although most recorded work ignals from meteor trails has been car- h high power equipment, some results ted with medium power equipment and urges amateurs to look out for short nals from the south during this period. of signals reflected from meteor trails observed. The first is from a meteor oes not cause a high ionisation density. type "pings" of signals lasting up to seconds are heard and this is the more f reflection occuring.

l is from an over-dense trail and signal a comparatively constant for a period of r three minutes.

ensive study of V.H.F. Meteor Scatter is provided in an article by Walter U, in the April 1957 issue of Q.S.T.

WANTED

Radio Officers and Traffic Assistants

for the

OVERSEAS TELECOMMUNICATIONS COMMISSION (AUSTRALIA)

The Overseas Telecommunications Commission operates Australia's overseas communications services through two main telegraph offices, five cable stations and six international radio stations, in addition to the Coastal Radio Service through 23 stations around the coast of Australia and in Papua/New Guinea.

TRAFFIC ASSISTANTS

Vacancies exist for young men up to 19 years of age with the Intermediate Certificate as Traffic Assistants in the Commission's telecommunications centre at Sydney.

Initial duties include recording, sorting and distribution of telegraphic traffic at a commencing salary of £351 per annum for those under 18, rising with age and experience to £796 per annum, while earlier higher salary ranges may be attained by qualifying as Telegraphist, Radio Officer or Radio Technician.

These are permanent positions with free or assisted training facilities and Commonwealth Superannuation.

RADIO OFFICERS *in the Coastal Radio Service*

For holders of a First or Second Class Commercial Operators' Certificate of Proficiency in Radiotelegraphy and Radiotelephony vacancies exist in the Commission's Coastal Radio Service.

Successful applicants who are medically fit have the opportunity to serve at stations situated in all capital cities and at other places around the coast of Australia and in Papua/New Guinea.

The salary range is £886-£1066 for holders of First Class Ticket or £856-£1036 for persons with Second Class ticket. Shift work is involved for which extra payments are made, while other allowances are payable at tropical and remote stations up to a maximum of £320 per annum for a married officer stationed in Papua/New Guinea or at Darwin.

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or ring BO544, extension 259, and arrange for an interview.

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EVENINGS and WEEKENDS: "KALUA"

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12 valve. Converted to 240v A.C.
Thoroughly Tested Re-aligned
Latest Ovaltone Permag Speaker

£34/17/6

Type T3 press to talk CARBON MICROPHONES

EXCELLENT CONDITION

12/6 ea.

NEW 24V MOTORS

Series wound Hi-Speed miniature. 12,000 RPM	£2/10/-
Shunt wound with gear box 2 speed 5 and 25 RPM	£2/10/-

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New C.A.V. 80 amp Generators. Ideal for lighting or fast charges

£10/10/-

Throat Mikes New	3/6
12V 420 watt Prefocus Globes	7/6

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All tested on TV picture

3BP1 with shield and socket	£3/17/6
VCR 97	£2/17/6
ACR2X & Shield	£3/0/0
CV 112 White 5"	£3/10/0

CV 254 9in Blue Screen, Magnetic Deflection & Focus

£4/10/-

Every tube capable of perfect picture
Fast persistence and simple construction using standard components

NEW AMERICAN HI-FI Dynamic Headphones

L. Imp. Padded Earpieces

£1/5/-

Postage N.S.W. 2/- Interstate 3/6

AR8-AT5 — COMPLETE STATION

AIR TESTED

Transmitter-Receiver, Aerial Coupler
Cables, Plugs, Phones, Mike
1 Crystal to desired Frequency
24V Power Supply & Circuits of 2 units
GUARANTEED IN PERFECT ORDER

£62/10/- Other voltages available

NEW B.S.R. FP10 GRAMO MOTORS

240 or 110
FOR THAT TAPE RECORDER

£1/19/6 POSTAGE 2/6

NEW VALVES

217C	10/-	6E5	12/6
12C8	12/6	12K8	12/6
6J8	17/6	VT502	12/6
VT501	12/6	7A6	7/6
EBC33	12/6	AV11	3/9
1H6	7/6	832A	£3/0/0
6L6	20/-	6K7	7/6
1C6	12/6	12SJ7	12/6
1G4	12/6	12SK7	12/6
1D4	12/6	12SL7	12/6
1J6	12/6	39/44	10/0
1K4	12/6	46	12/6
1K6	12/6	47	12/6
1LH4	12/6	78	12/6
1P5	6/6	828	£2/10/0
6A6	12/6	843	£1/10/0
3A4	15/-	957	6/6
3B7	10/-	1625	£1/0/0
3D6	10/-	1629	10/0
6AG5	9/6	4307A	10/0
6AM5	15/6	1619	£1/0/0
6AM6	17/6	2050	£1/0/0
6H6	7/6	9001	8/6
6J6	15/-	9003	12/6
6J7G	9/6	9004	8/6
6N7	10/-	RK75	10/0
6SK7	12/6	VR75/30	15/-
6SL7	12/6	RK48A	£3/0/0
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KTW62/6U7	7/6	1T4	12/6
1M5	7/6	1A5	7/6
1D5	7/6	7193	3/6
CV6	3/6	829B	3/-/-
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VR65A/SP41	2/6	6B8	12/6
KT66	27/6	307	£1/0/0
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6X5	10/-	866A	15/-
1Q5	6/6	6AC7	3/6
811	£1	EF50	3/6
X61M	17/6	100TH	2/5/0

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6V. 12V. 24V. 32V. DC to 240
60 Watt to operate Radio, Fluoresc
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325 x 325 125 12V.	£3 1

INVERTER TRANSFORMER

6V 240V 40 watt	£3/
12V 240V 60 watt	£3/
32V 240V 60 watt	£3/

C.R.O. TRANSFORMERS

350 x 350 extended to 100
6.3V 6.3V 215V 4V **£4/5**

POSTAGE N.S.W. 5/- INTERSTATE

New A.R.B. Receivers

8 Valve
4 Band 195 KC To 9.025 Megs.

24V D.C. Operation	£22/1
Converted for 240V A.C.	£33/1

RELAYS

6v. 3Ple Miniature	1
1700 SPDT	7
1300 SPDT	7
500 x 500 SPDT	7
12 volts DPDT 5 amp	£1/
24 volts DPDT	12
8-16 volt DPDT	12
11 volt AC	£1/
Hi-speed Polarised relay	£2/1
400 ohm	12
1300 ohm DPDT	1

½in Square Section DURAL T
ING UP TO 12ft lengths 1/- per
Hi-lo Phono Transformers ..
Spirit Level Bubbles, mounted
Canadian Signal Lamps .. ..
Hi-voltage Lead-Thru Insulators
1/6 each, 15/-
Hydrometers, Battery Testers
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Multi-Strand 4 core Cable,
Yard, 1/-; 100 yards £2/1
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60 pf with Vernier £1/
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ADIO

PHONE
LA 3845

VICTORIA R'D. MARRICKVILLE, SYDNEY, N·S·W

TRAM AT DOOR. STOP 42
COLLAROY ST., COLLAROY—XW5956

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RANSMITTERS

12 Volt operation
9 megs. 10 watts output
tested complete with 1
Crystal
£29/10/-

NEW POWER
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5V 300 MA	£3/17/6
Chokes	£1/15/
Chokes	£1/-/

EW COPPER OXIDE RECTIFIERS

amp Bridge	£1/2/6

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Roller value chart
tested. All ranges.
Perfect order
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2 to 8 megs as above. Converted to Crystal Control. Power increased to 20 watts Includes Plugs & Cables Crystal Mike, Speaker, Circuit, etc. Crystal frequency conforms to PMG requirements for small ships and other services.

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1UF 600V	6/6	5UF 2.5V	6/6
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No Plugs & Cables
£16/17/6

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Hand sets	£1/9/6
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Hand sets with pressel-switch	£1/15/
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Miniature telephone units to suit Hand sets or H & B, 10/-

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8 day movement Cost Govt. £28
2¼" £4/15/0
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Rotary D.P.D.T	3/9
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Postage 6d.

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Standard or miniature to suit all valves

Coils B/C 455 KC	9/6
Coils S/W 455 KC	9/6
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Slug tuned H.F. coils suit 44 meg.	4/6

GENEMOTORS

nput	Output					
24V	250V 100MA		£1	0	0
24V	550V 375MA		£2	0	0
24V	250 V 60MA		£1	5	0
12V	500V 350MA		£8	10	0
12V	1200V 200MA		£6	10	0
6V	500V 150MA		£6	10	0
24V	250V 100MA.	New	£2	0	0
12V	300V 250MA		£4	10	0
12V	235V 50MA		£2	15	0
12V	350V 50MA		£2	15	0

PECIALS FOR JULY ONLY

RE OVERSTOCKED. WE NEED THE SPACE. PRICES APPLY ONLY FOR 1 MONTH.

.11 TRANSCEIVERS

le with valves power supplies
Plgs Cables Phones Mike.
£10/10/-

Electric 24v to 32v ydraulic Pumps

uty motor develops 1 hp cont intermittent. Ideal motor for oper wer tools off 32V-DC.

£1/15/-

LISH I.F.F. UNITS

dition V.H.F TX. RX 10 valves emotor and a host of parts. No ts

£2/17/6

es P.A. Horn Speakers

ns. O.P.T.X. 500 & 1000v fitted ndition **£19/10/-**
flex Horns **£22/10/-**

NEW TRANSMITTING VALVES

Also, suitable for industrial heating

806	£3/-/-	811	£1/-/-
829B	£3/-/-	217C	10/-
100TH	£2-5-0		

POSTAGE 2/6

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Laboratory Standard Instruments. Will operate to 3000 Pulse per minute
£1/7/6 BASES 10/- extra.

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17 valves 100 to 156 Megs Complete with valves
£14/10/-

200 Watt P.A. Amplifiers

805 P.P 240V. A.C Power. Output matched to 100V
£47/10/-

NEW COPPER OXIDE RECTIFIERS

24V. 100MA. BRIDGE, ideal for trickle Chargers. Relay operation etc.
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24v 6 amp full wave
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Fully filtered. 250V 60 MA Output & 6V. 2.5 Amp. Secondary.
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8 VALVE RADIOGRAM HI-FI CHASSIS

Dual wave, bass & treble boost tuned R.F. stage 12" speaker.

£28/17/6

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DUAL WAVE 12in SPEAKER

£18/15/-

5 valve also available as home constructor's Kitset **COMPLETE WITH CIRCUIT £14/15/-**

7 VALVE DX RECEIVER

3 band, 2 to 6 to 18 megs 160 to 16 metres and broadcast. Exceptional selectivity sensitivity 2 microvolts. **NEW AUSTRALIANS,** listen to European short wave stations.

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6 Valve	10 watt	£14/17/6
6 valve	25 watt	£25/7/6
6 valve	40 watt	£32/7/6

BATTERY ONLY OPERATION

6 valve 6 volt 10 watt **£18/15/-**
7 valve 12 volt 10 watt **£19/15**
7 valve 12V 25 watt **£24/17/6**

BATTERY AND A.C. OPERATION

6 valve 10 watt 6V **£20/15/-**
7 valve 12 watt 12V **£21/15/-**
7 valve 25 watt 12V **£29/7/6**

HI-FI RANGE

MULLARD 5/10

£34/15/-

Complete with Jensen twin cone speaker, Ferguson O.P transformer, 30% & U.L. taps.

MULLARD 5/20 AS ABOVE

£42/15/-

Tuner & separate control box with mike, pre-amplifier.

£12 extra

THE FINEST SET AT ANY PRICE

CHECK THESE EXTRA FACILITIES

Built-in Preamplifier to suit crystal microphone tape deck, electronic guitar, sound on film TV, etc.

Hear it demonstrated on these units

DEMONSTRATIONS EVERY SUNDAY 2 to 5 p.m.

OR EVENINGS. BY PHONE APPOINTMENT

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CABINETS AND ALL ACCESSORIES TO SUIT

THE OUTSTANDING 10-VALVE HI-FI

RADIOGRAM CHASSIS

Incorporating Mullard 5/10 bass boost amplifier, treble boost dual wave tuned R.F. stage Built-in pre-amplifier for microphone or tape recorder including Jensen twin speaker.

£44/15/-

Dual wave, 6 valve radiogram chassis includes bass & treble boost, 12" Jensen or Magnavox speaker.

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Formers in cans with special V.H.F. tu slugs and winding data for video sound I.F.s and traps. 6,
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Video and sound I.F.s ratio detectors traps to A.W.A. circuit specifications aligned 19/
Wired and tested video and sound strip with traps and ratio detector in ing valves and circuit. Including v £2
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N.B. All equipment complies with P. specifications.
Turrets, line transformers, yokes, defle coils and standard 17" tubes avail Also first class technical and align service.
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R.T. & H. TV KIT

NOW AVAILABLE

SEE IT IN OPERATION

T.V. TEST EQUIPMEN

Crystal marker genera 5½ megs. & every ½ m to 50 megs.

£22/10/-

R.T. & H. WIDE RAN C.R.O.

Wired & Tested.

£52/10/-

Also simplified versio 6in C.R.O. P.P. Deflecti

£44/15/-

4 SPEED PLAYERS

£11/17/6

4 SPEED CHANGERS

£16/17/6

E NEW SCIENCE OF TRAFFIC CONTROL

(Continued from Page 19)

the edge of the roadway.
have been known to become
ioned to this that under cer-
circumstances will fail to respond
en change in the marking and
he road or collide with other

r example of conditioned re-
ten met with is where a motor-
velling a "through" road and
hat cross traffic seems to pull
im at every intersection, thus
m a clear run through. He
so "conditioned" to this that,
is suddenly confronted with
notorist at an intersection with
idea it requires an unusually
e to react and gain control.
n causes collisions at intersec-

OF SPEED

Engineers have various meth-
udying speeds on roads. Space
permit of details of the various
sed for this. They range from
tubes across the road actuat-
ing devices to radar.
is divided into five classifica-

eed is the instantaneous speed
le at a specified location. Run-
d is the average speed over
ourse. Operating speed is the
speed sustained over a given
ruising speed is the running
the vehicle without impediment.
eed is the effective speed over
etween terminals.
se, spot speed is the one of
importance, as it determines
acteristics of the road user,
olume of traffic over sections
ays such as bridges, etc.
udy of speed values has re-
me peculiar characteristics of
s.
er travels faster the farther he
a given trip. For long trips
miles he will travel faster
uch as 30 pc compared to
s.

E WHEN ALONE

river travelling alone travels
erage at a speed 2 to 3 miles
faster than when carrying pas-

try to general thought among
men travel at about the same
even a little slower than males.
e free moving traffic conditions
of vehicle influences the spot
Buses are fastest, followed by
icks. For each year of age,
decrease speeds about 1.5 miles

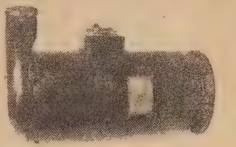
avel surfaces, spot speeds are
miles per hour below hard
eds.
dges, the spot speeds are usu-
r than on level roads, but this
cording to the type of bridge.
der bridges 24 feet or more
two lanes cause little reduc-
peed, whereas long high truss
4 feet wide will cause a reduc-
pot speed of 7 miles per hour.
eater the number of intersec-
sed over a given time or dis-
e greater is the reduction in
ds. Thus in suburban or city
ot speeds average 25 to 30 miles per hour, while in country districts it averages 40 to 50 miles per hour.

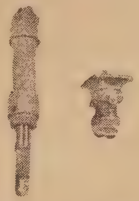
The traffic engineer studies shapes of roads, angles of curvature, different road surfaces, volumes of traffic, types of vehicles, distribution of traffic, origin and destination, stream characteristics, intersection characteristics, parking characteristics, accident characteristics, driver controls, one-way streets, and so on.

From these studies he is able to design measures for control by regulations, signs and signals which, together with a knowledge of the psychology of the individual, tends to make the best use of existing facilities and better design of new facilities.

400-700 GALS./HOUR PUMP AND MOTOR
24-32 volt operation. Suit fresh water, fuel, etc.
£14/-/-

P.I. GENERATORS
24 volt, 200 amp. Ideal Welder
NEW £30 Reconditioned £27/10/-





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Write for details and technical advice
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6000-1, 12-24 volt. As used for control of amateur wireless masts
£12/10/-

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360 ELIZABETH STREET
SYDNEY
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FREQ-KC
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BRIGHT STAR RADIO
GLEN IRIS VIC
MADE IN AUST

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VACUUM MOUNTED CRYSTALS
for general communication frequencies in the range 3 — 14M.C. — Higher frequencies can be supplied.
IMMEDIATE DELIVERY OF THE FOLLOWING FISHING CRAFT FREQUENCIES
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AMATEUR TYPE CRYSTALS 3.5 AND 7 MC BAND
(IN F.T. 243 HOLDERS)
£3/-/- each. Plus 12½% Sales Tax. REGRINDS £1/10/-
Crystals for Taxi and Bush Fire Sets also Available.
We would be happy to advise and quote you as to the most suitable for your particular application either in the pressure or vacuum type holder.
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BRIGHT STAR RADIO
46 Eastgate St., Oakleigh, S.E. 12; Vic. UM3387.

ULTRON 15 series
TAPE HEADS *Extraordinary*

FEATURING:—

- ★ Extreme Frequency Range.
  (20 cps. to 20,000 cps. at 7.5 ins. per sec.)
  (20 cps. to 30,000 cps. at 15 ins. per sec.)
- ★ Triple Magnetic Shielding (—30dB at 50 cps.)
- ★ High Output.
- ★ Micro-aligned Gap (record and play with separate heads with no treble loss).

THE ULTRON 15 series are recommended for:—

- ★ Professional Transcription.
- ★ All Laboratory Uses.
- ★ Full Frequency Reproduction of Pre-Recorded Tapes.

By far the most advanced range of tape heads available, the ULTRON 15 series is produced in the following types:—

ULTRON 15, ULTRON 15T, ULTRON 15L Record-Play, high impedance, .00017in gap
ULTRON 15H, ULTRON 15HT, ULTRON 15HL . . Record-Play, medium impedance .00017in gap
ULTRON 15S, ULTRON 15ST, ULTRON 15SL . . High-Efficiency Record. .003in gap
Note—"T" denotes standard half track; "L" denotes lower half track All others are full track.

SEND 4/- POSTAL NOTE FOR BOOKLET "MAGNETIC TAPE HEADS," containing full specifications of all L.B. Products' tape heads Hi-Fi Tape Circuits, etc.
A FREE COPY IS SUPPLIED WITH EVERY HEAD.

Retail Prices: ALL ULTRON 15 series £9/13/9
Types HE2, HE2T (record-play, commercial quality) . . £6/ 3/-
Types EU, EUT, EUL (high efficiency erase) £5/ 7/-

Available from:—

Victoria:—Homecrafts Ltd., 290 Lonsdale St., Melbourne.
S. Aust.:—A. G. Healing, Ltd., 58 Flinders St., Adelaide.
Queensland:—A. E. Harrold Ltd., 123 Charlotte St., Brisbane.

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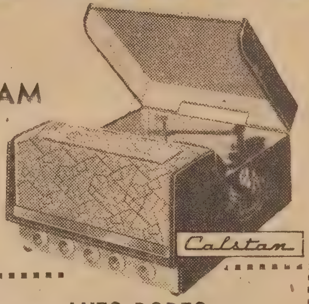
YOU MUST SEE AND HEAR THE

★ ★ ★ Calstan ★ ★ ★

Star Chief

AUTOMATIC
PORTABLE
TABLEGRAM



- ★ Powerful 5 valve Dual-wave radio
- ★ Microgroove 4-speed automatic changer (8 to 10 records).
- ★ Carrying case covered in 2-tone washable nylex with gold trim.

. . . also one of Australia's Best-selling Portables

Calstan AUTO-PORTO
All wanted modern features, 4-speed automatic changer, 5-valve Dual-wave. SENSATIONALLY PRICED.

AT ALL GOOD RADIO STORES

Manufactured and guaranteed by
ZENITH RADIO CO.
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FROM THE SERVICEM
WHO TELLS

(Continued from Page 61)

As the afternoon wore on snipp
conversation wafted over the fenc
gave me an inkling of what they
doing:

"Try the red one."

"This one goes to frame."

"Anything on that one?"

"Switch it on now."

And so on.

It didn't need a Sherlock Holm
deduce that they were working
car wiring; probably rewiring a
part of it. Apart from registerin
fact I didn't take much more no
the situation until much later i
afternoon.

Then: "Righto Charlie, try it

Followed the whine of a starte
the roar of a motor bursting int
It revved moderately fast for
minute or so, then cut abruptly, as
someone had switched off the ig
without lifting their foot fron
throttle.

"What's the matter?"

"I dunno" (then somewhat deje
"but when I switched the tail lig
the motor cut out."

Well, that's one way to switch
motor I suppose.

A SIMPLE COURSE
IN RADIO

(Continued from Page 47)

rier, without affecting its am
This is then known as FREQU
MODULATION.

This latter method has certain
tages in regard to fidelity and f
from background noise, and is cu
used for television sound channe
for the present, the beginner car
to think in terms of the more
amplitude modulation.

We can thus complete the
with a fairly clear idea of a radi
mitter.

First an oscillator generates
frequency voltage, which is sub
ly greatly amplified to form the

Then, in the studio, a mic
which converts sound waves int
frequency signal voltages. Th
amplified and ultimately utilised
transmitter to vary the amplit
frequency) of the carrier wave
Finally the modulated car
applied to the aerial and the h
quency signals, carrying the sou
tern in electrical form, are radia
space.

NEW BOOKS

VISION EXPLAINED, by W. r. Sixth Edition revised by E. Spreadbury. Hard cover, 175 x ½in pages. Photographs and cir- grams.

a book runs to a sixth edition usly has some definite appeal. not hard to find in the case of on Explained" which does just title suggests in a simple and orward way. It is the type of t most non-mathematical radio- ld read straight through from cover gaining a good deal of ion on the way. A second care- ing and it would be reasonable a good basic knowledge of tele- inciples.

mention is made of the Aus- elevision standards but the em- roughout is on the British 405 tem which has a number of ntal differences to our own. The hannel for the British system, ple, is of the amplitude modu- ariety rather than frequency d as in most other systems. video modulation with 405 lines bed while we are employing a modulation 625 line system in a.

ook could be a real help to the it receiver owner who wishes to ore about general principles han to the service technician u to gain practical knowledge of l receivers with a view to trac- s and carrying out re-alignments.

opy of the book direct from the rs, Iliffe and Sons Ltd., Stam- Seet, London. The local price is to be in the vicinity of £1/1/ F.

DBOOK OF BROADCASTING damentals of Radio and Tele- y Waldo Abbot and Richard L. Hard cover, 531 pages, 9in x tographs and drawings.

ourth, and up to date, edition of originally published 20 years "Handbook of Broadcasting" ed for the student of broadcast- nique from the point of view of production rather than that of ronic engineer. Its authors are d, one with University of and the other with the Uni- f Illinois.

of 29 chapters deal with most f both radio and television pro- Among the chapters are nentals of Radio" and "Funda- of Television" being very brief ces of the external technical the actor needs to understand. c of the book is made up of such as "Pronunciation," "Music s," "Broadcasts to Schools," g the Television Play" and "The of Radio and Television."

ping with its purpose as a col- t, the book concludes with a of class projects and assign-

opy direct from the McGraw- ternational Corporation, New .S.A. The American price is llars seventy-five cents (M.V.F.).

LET'S BUY AN ARGUMENT

(Continued from Page 83)

found myself looking for a cure. Silicone compounds were out, because none were available.

What about other greases?

I suddenly remembered a particularly sticky variety, which I had once bought for use with the family car. Packed in a green tin, it rejoiced under the title of "Energol N2, WB and Uni. Joint" grease.

It proved to be just as "gooey" as I had remembered and would not melt and run, on even quite hot regions of the soldering iron.

Intrigued by its tenacity, I began to wonder about its electrical properties, which must certainly have been quite incidental to the original purpose for which it was compounded.

The multimeter showed no measureable conduction while a Q-meter test, next morning, showed no appreciable reaction on the properties of a coil.

A conversation with the manufacturers established that this particular grease did, in fact, have a very high temperature rating and was electrically inert, being compounded with a fibre filler. The same was not true of all special greases, however, some of which are compounded with aluminium, lithium or other metallic substances.

By sheer good fortune, I had picked one of the most suitable of their automotive greases. How it would compare in the long run with silicon is another matter but the cost, at a few shillings a tin, is a very different matter.

By rolling the core in the grease, it would stick well to the sides and carry into the former with it. Put a bit into the former as well, and it would form a sticky pad underneath, further to restrain accidental movement.

Now all this isn't meant as a plug for Energol WB and Uni. Joint grease. There may or may not be other greases which have characteristics more favourable to the job of sticking cores in place, without setting or without melting at normal cabinet temperatures.

It's just an interesting line of thought, particularly for those of our readers who combine an interest in radio with a knowledge of industrial chemistry.

What about it then? Is there a better grease available for the job? Is there some other soap-like substance which might be better again?

BUILDING OUR 17-INCH T.V. RECEIVER

(Continued from Page 79)

leads are kept short and placed logically, no special difficulty should be experienced in duplicating the factory-wired unit. Unless alignment facilities are available, however, such readers will probably need to have the unit aligned by some firm offering this service.

Our impression of the Q-Plus channel is that it can only be aligned satisfactorily with a wobbulator and CRO. We obtained peak results and the curve illustrated earlier by adding slight extra coupling between the "P" and "G" pins on the first double-tuned transformer and also the transformer feeding the video diode.

The extra coupling involved two pieces of thin hook-up wire attached to the respective pins and twisted together for about ¼in.

It also helped matters to load the tuned output coil of the tuner and values down to 1,000 ohms can be tried.

The R.C.S. IF components, which are currently just being released, use bifiler transformers in place of the double-tuned overcoupled variety supplied by Q-Plus. According to the manufacturers, R.C.S. components may be wired to their own circuit or to the original circuit in the R.T. and H. receiver. They advise the use of two sound stages, however.

The transformers are mounted on a composite video-sound strip which fits the R. T. and H. chassis. The slugs are set in deliberate positions such that, allowing for normal short leads, the stagger-tuned frequencies should approximate those required for a favourable bandpass.

AWA RONETTE

MICROPHONES & ACCESSORIES

Type C53

£4/19/-

Hand or stand mounting. Omnidirectional, black plastic housing and hand grip. Ideal for tape recorders and similar applications

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Handwork in Wood	Noyes	45/-
Bent Tubular Furniture	Groneman	28/9
Six Foolish Drivers	Schlichenmaier	12/-
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SPECIAL PURCHASES

NEW MICRO-AMMETERS

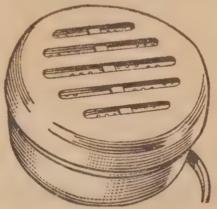
NEW PATON MICRO AMMETERS, 0-500, M.A. 1¾in diameter. Flush mounting.

25/-

Post and Packing **2/6.**

METER RECTIFIERS

WESTINGHOUSE 1M.A. METER RECTIFIER. FULL WAVE. NEW. **15/-**



PILLO-FONE

EXTENSION-UNIT

IT'S A REAL MINIATURE WITH ROLA UNIT.

Install it anywhere, in the sick-room, work-shop, garage or any room in the house. Just connect across voice coil of the existing speaker. The "PILLO-FONE" IS THE MOST CONVENIENT LITTLE UNIT YET DEVISED 3¼in Diameter, by 1⅞in deep. POST FREE **22/6**

("Mercury" American Made.) These relay counters register from 0 to 99,999 can be supplied with 250-ohm coil 24v D.C. operation.

25/-

Plus Postage

NEW AMERICAN BOX KITES

These kites are constructed of Silk with Metal Frame.

SIZE 15in square x 3ft long. Originally used for Aerials for Lifeboat Transmitters.

30/- Post 2/-.

No. 19 TRANSCEIVERS

These units cover a frequency of 2 to 8 mc and contain 15-6.3v valve, including 1-807, 2-6V6S, 6-6K7G, 2-6K8G, 6B8S ETC, 0-1MA-Meter, 4-GANG cond. H.F. Unit ETC. **£6/15/-** F.O.R.

12v Gene Motor for above, **£3/5/-** F.O.R.

VALVE SPECIALS

20/- will purchase any one of the following valve Specials.

2	EL3NG	3	6K8G
3	1P5	5	6SH7
3	1Q5	6	6AC7
5	1C7	4	6J7G
10	1KS	4	KTW62/6U7
5	954	4	12A6
5	EF50	2	6X5GT
3	6SA7	8	EA50
		5	6K7G

Post and Packing 4/6 extra.

ALL VALVES ARE NEW

TRANSMITTING VALVES

829B	£3	5	0
100TH	£2	10	0
866		15	0
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English Turner 3in Flush Mounting 0-10 mA 15/-

0-600 volt 3in flush with shunt **15/-**

Paton Plug-in type 0-1 amp or 0.350 ma R.F. .. .. **7/6 New**

Used but in good order **5/-**

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0-5, 0-25, 0-250 4in meter mounted in case, used but in good order **£1/2/6**

All Meters—Plus Postage

NEW ROTARY-CONVERTERS

24 to 32 Volt D.C., Input, Output, 240 Volt 50 Cycles at 150 Watts. Suitable for Tape Recorders, Radiograms, Amplifiers, etc.

£16/15/- F.O.R.

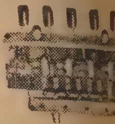
No. 122 TRANSCEIVER

In new condition, complete w valves, vibrator power supply. lea and dynamic microphone and he phones. These units are easily c verted to comply with P.M.G. requ ments for small boats, etc. Freq. 2 t meg.

£19/15/-

Packing 20/- extra.

NEW PUSH-BUTTON SWITCHES 20/-



Five pole push-button switches New control box fitted with above switch also 5 bezels with globes and multi contact key switch.

Post: N.S.W. 2/-
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NEW B.S.R. MOTORS

These English B.S.R. Motors as u on most tape decks, also have m other uses. Size of motor, 3in x x 2¼in with 3/16in shaft, for 240 or volt AC operation.

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Used, but in good condition

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New H.M.V. spring grammo motors turntable. Adaptable for many uses
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Small Plate 0-70 PF, Single H Mounting, Long-spindle .. .. ..
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American selsyn motors 50 volt tr mitter or slave.

£1/17/6. Plus 4/6 Post.

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New motorised hydrauli pumps complete with he duty 24 volt motor.

35/- F.O.R.

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Heavy duty 12v Genemot ideal for public address tems etc. Two separate puts — 270v at 110mA 550 at 55mA **£4/-/-** F.O.R

Please address all correspondence to 479 Parramatta Road, Leichhardt, N.S.W.

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332 PARRAMATTA ROAD, STANMORE, N.S.W. PHONE LM7398
479 PARRAMATTA ROAD, LEICHHARDT, N.S.W. PHONE LM3610
640 KING STREET, ST. PETERS, N.S.W. PHONE LA6087

NEW VALVES

A	3/6	1P5	7/6	866A	15/-	AV11	5/-
SI	5/-	6Y6	10/-	83	10/-	829B	£3/15/-
H	3/11	6K8G	11/6	EL33	12/6	828	£1 15/-
A T	9/6	71A	7/6	CV6	3/-	100TH	£2 10/-
O	9/6	EK32	15/-	6F6	9/6	EZ82	9/6
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L	9/6	KTW62/6U7	7/6	12A6	12/6	4307A	10/-
C	9/6	6J8	15/-	6J7	8/6	12SR7	3/6
U	7/6	EF8	9/6	5U4	12/6	1H6	7/6
S	9/6	7C7	3/6	954	5/6	1J6	7/6
S	9/6	7A6	3/6	955	5/6	1D5	9/6
J6	12/6	78	7/6	VR65A	2/6	81	15/-
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ALL VALVE PRICES PLUS POSTAGE

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NEW POWER RANSFORMERS

rim.: 240v with 230v tapping, 5 x 285 with 6.3v filament in

24/6

stage: N.S.W., 3/6; INT., 5/3.

CA CONDENSERS

Mica Condensers, small types. .00003 to .005 in- most wanted values.

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Midget Power Trans.

Prim. 250v. Sec. 225 x 225 v Fil. Winding. Upright, or unting. Size 2in x 2½in.

22/6

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525v	4/6
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12v	1/6
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d 25v	3/6

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ge, N.S.W., 6/6; INT., 9/6

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5C Standard 22/-
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Supplied with 5T, 7T, or 10T, Transformer.

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6in x 9in Oval Dynamic Speakers with 5T or 7T Transformer.

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B/C Coils, shielded 9/6
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Box of 10 new Carbon Potentiometers.

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Boxes of 100 new mica paper and electrolytic condensers in values ranging from 50pf. mica to 5 400v paper. Values include .0001, .00025, .00075, .01, .02, .05, .1. Also 500 mfd/12v, 10 mfd/40v, 8 mfd/525v, 16 mfd/350v, electrolytics.

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½ Meg. Miniature Switch Pots, d/p Switch Long Spindle	5/6
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Dads, too, can enjoy the fun of this instructive hobby.
We list below details of some of the components you will need. All are of highest quality and at a very reasonable cost.

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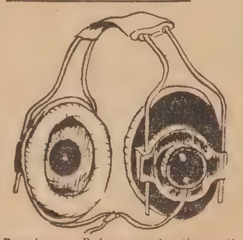

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Ex-R.A.A.F. 3000 ohms. Complete with chamois covered Rubber Ear Muffs. Defies external noises
PRICE: 32/6 pair.
Packing and Postage (all States) 3/-

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Don't pay high prices for replacements. See our low-priced lots. All Valves and Brand New and in original cartons. Special prices for quantities on application.

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1K7G	3/6
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12A6	7/11
12K8	12/6
12SC7	12/6
12SJ7	12/6
12SL7GT	10/6
12SF7	12/6
1626	5/
1629	7/6
1632	12/6
2C26A	17/6
2A3	15/
25Z6	15/
25L6GT/G	15/
2051	12/6
6A6	10/6
6A8G	12/6
6U7G	6/9
6B4G	10/6
6C8G	12/6
6E5	7/6
6F6G	8/11
6H6GT	3/11
6K7	6/11
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6SL7GT	12/6
3Q5GT/G	12/6
6L7	12/6
6Q7G	12/6
6V6G	12/6
6Y6G	12/6
6AC7	3/11
6AJ5	12/6
6SA7GT/G	8/11
6SF5	7/6
6SH7	4/11
6SH7GT	4/11
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6J7GT	7/11
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7C5	5/
7C7	5/
7W7	5/
705A	15/
7193	2/11
801	25/
803	40/
807	19/6
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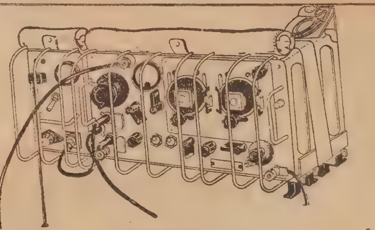

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● Approved by P.M.G for general use. ● Uses current series of valves. ● Has 12 volt operation. ● Frequency coverage 2 — 8 mcs ● Crystal controlled. ● Two crystals of nominated frequency between 2 and 8 mcs. supplied. ● Complete with dynamic microphone, earphone and speaker. ● Range 50—300 miles.
Ideal for Fishing and Pleasure Craft, Bush Fire Brigade, Boat Owners All sets are Air Tested. **Price £59/17/6.**

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Dia.	Gauge
1¾in	3/64in
1 3/8in	3/16in
1 3/8in	3/32in
1¼in	3/64in
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1in	3/32in
7/8in	3/32in
¾in	3/32in
¾in	3/64in
9/16in	1/8in
7/16in	1/16in
5/16in	1/16in
¼in	1/32in
5/32in	1/32in

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AIRCRAFT METER

PRECISION AIRCRAFT INSTRUMENTS

Huge stocks including Turn
Bank, Air Speed, Pressure Ga
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etc., etc.
TO CLEAR ONLY 7/6 each
We also have in stock some
to get SUPER SENSIT
ALTIMETERS.
PRICE £6/10/- each.
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RADIO TRANSCEIVE

No. 11 Transceivers (Receiver T
mitter only) complete with V
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Low Power Supply 12 volt —
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and 1 amp . . . . . .
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Supplies. Valves, Meter. C
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Model 305G

A multi-range CIRCUIT TESTER of high sensitivity, fitted with a 40-micro amps full scale meter. Beautifully finished in black plastic

Size 5¾ in x 2½in x 3¾in.

AC volts—10, 50, 250, 500, 1000v (8000 Ohms/volt).

DC volts—10, 50, 250, 500, 1000, 5000v (20,000 Ohms/volt).

DC current — 50 micro amps; 2.5 M/A; 25 M/A; 250 M/A.
Resistance—5K, 50KK, 500K, 5MG (2 x 1.5 Batteries contained).

Decibels—0 db—plus 22 db (at AC 10v range).

0 db—0.775 v—600 ohms.

Packing and Reg. Postage, 6/-

Price £15/15/-

Model SP5

It is only on rare occasions we have sufficient stocks of these Meters to warrant advertising; so if interested we suggest you waste no time inspecting them. NOTE: All Multi Meters are brand new in cartons.

A very compact Multi-Range CIRCUIT TESTER of high sensitivity, equipped with a Rotary Switch for selecting ranges. Built of first quality parts, this unit is recommended to all Radio Enthusiasts.
Ranges: AC volts—10; 50; 250; 500; 1000 volts (2000 Ohms/volt).
DC volts—10; 50; 250; 500; 1000 volts (2000 Ohms/volt).
DC Current—500 micro amps; 25 M/A; 500 M/A.

Resistance—0-10 KK Ohm; 0-1 Meg. Ohm.
2 x 1.5v dry Batteries inbuilt.
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Price £7/10/-

Casey Model H10

A pocket-sized MIDGET CIRCUIT TESTER.
Grey panel and case of synthetic resin and contained in leather carrying case.
Ideal for Amateur Radiomen, Testing Home Electrical Appliances, Testing Automobile Circuits and Batteries, etc.
Ranges: AC volts—6v; 60; 120; 600v (2000 Ohms/volt).
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DC Current—120 M/A.
Resistance—0-1000K.
Size—3½in x 2½in x 1¼in.
Price £6/19/6
Packing and Reg. Postage, 6/-.

Sydney only

SWITCH UNISELECTOR
Bank 11 Position.
new 50/-

RHEOSTATS HEAVY D
60 ohms, 1.4 amps.
new 25/
25 ohms 2.70 amps.
new 27/
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Switch Circuit Breaker 2
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NSWERS TO CORRESPONDENTS

'arrangindy, Brisbane, Qld.) wishes we are able to supply a copy of 1955, issue, containing an article of a Vacuum Tube Voltmeter. nately the issue that you require le from our back dates department. that you refer to the classified last page of this journal, where s have, from time to time, adver- imbers at reasonable cost.

Colah, NSW) writes of a difficulty d in a Control Unit No. 4. Accord- it was necessary to insert a .2 between the moving arms of the and a section of the bass switch, ormally joined together. Failure prevented the treble controls from C.M. would like to know the his behavior.

cluding the resistor mentioned, the the treble control would be made ore severe than intended and would ig" degrees of treble cut. The tion was to give specific degrees cut to suit wide-range equipment. y appear to be inadequate if judged t having limited treble response.

heodore, Qld.) informs us of a dress and goes on to express his the performance of the '57 Port- e has just completed. One point rry our correspondent, namely, a listortion at maximum volume.

omplaints about distortion at maxi- in portables arise because it is ed that portables have only limited usually about a quarter of a watt. nal area this may be achieved with control set at about a quarter to ion. Turning the volume up to m or maximum, merely produces ortion.

me applies to the '57 Portable which, with the 6AQ5 in circuit, is limited n output of about one watt.

an error occurred in the original e power supply published in the 56. issue. A correction was sub- lished but, in case you are not nature of this error, the values on were interchanged. The resistors ohm and the 2000 ohm dropping he high tension and low tension

(Sisbury, Qld.) writes to tell us of vith the transistor set described in 7, issue. As well as good reception he local stations he is also receiving lia and some foreign broadcasts.

thanks for the comments, J.D.C., glad to hear that you are having cess with the little set. We are nore elaborate set at the moment hat you might find it an interest- lso. Your reception of short-wave line with several other readers who is on this matter. Strangely enough, to have done the logical thing in tances, so far, and wound a coil se ranges, rather than depend on random effect. We suggest it worth trying.

scot Vale, Vic.) inquires about the described in the February, 1956, It page, being apparently puzzled onnections.

nately you have not stated your ompletely as is desirable, D.J.Mc., es it hard for us to help you. The chased should have a data sheet connections or you should be able e from the makers. We imagine t may be worrying you is the pre- e types of coils of two aerial con- e being intended for use with dif- of aerials. It is merely a matter hever one gives the best results.

wood, NSW) intends to build the escribed in the March, 1957, issue, trodynamic speaker and a 385 volts er transformer. A.T. would appre- vice on any alterations that may

of an electrodynamic speaker and le transformer will not be a major the above set. The existing filter be used and a standard capacitance vith a 5Y3 or similar rectifier, will The value of the first filter capa- e to be 8 or 16 mfd and rated at he least. The second filter capacitor ave a similar rating but the specified e retained. The speaker field coil as a choke between the two filter A dropping resistor after the filter, utput valve screens and the preceding e necessary and the specified value ed.

of the output valves should be fed ond filter capacitor, at which point be about 260 volts. Any excess voltage will have to be got rid of. The best method of doing this is to insert a heavy duty resistor between the filament of the rectifier and the input to the filter system. A resistor of a few hundred ohms would be adequate and would limit the peak voltage from the rectifier.

L.G.H. (Box Hill, Vic.) says he likes reading R.T. and H. and would like to see a discussion of mercury cells in "Answer Tom". He would also like to see the "Course In Television" released as a book.

A. Thanks for your appreciative remarks and for the suggestions. We will pass your request on to the staff member who looks after "Answer Tom". We'll make a decision about the "Course In Television" later, when it is nearing completion.

T.J.S. (Hawthorn, Vic.) says that he connected a 0.1 meg. potentiometer in series with the positive lead from the B-battery to his one-valve set. Turning the pot. to full resistance appeared to bring in another station close to the one he was listening to, and also affected the tone Why?

A. We tip that turning the control to maximum affected and reduced the amount of regeneration, which would have a secondary effect on both selectivity and tuning. As for the change in tone, this could also be due partly to the change in regeneration. More especially, however, introduction of the resistance would upset the audio return circuit and make the phones sound more peaky. They would deliver highest output at frequencies where their impedance was highest.

R.D. (Meadowbank, NSW) sends in a number of queries for the "Answer Tom" feature and suggests that we describe a crystal set amplifier, preferably using the types 30 or 19 valves.

A. Many thanks for the queries and suggestion, R.D.; we shall include the queries at the earliest opportunity. An amplifier to suit your requirements was described in the June, 1949, issue and reprints of the circuit and text are available through our query service.

W.J.C. (Canberra, ACT) writes to say that he has completed the 17-watt U-L amplifier and Control Unit No. 4, both of which are performing very well. However, he finds that the gain is not sufficient for use with a variable reluctance pickup and would like us to suggest a means of increasing the gain without prejudicing the performance. He would also like our opinion on whether it is advisable to rewire the EF86 in first stage of the amplifier for pentode operation.

A. We feel that the 17-watt U-L amplifier has as much gain as is permissible for this type of circuit, and it would not be possible to increase the gain without inviting trouble with noise after the gain control. Rewiring the EF86 as a pentode or decreasing feedback would alike produce this effect. The lack of gain is due to the control unit, but the simple addition of a preamplifier stage would almost certainly cause instability. The most logical solution would be the use of a control unit suitable for the pickup and we advise the Control Unit No. 6.

J. M. (Nathalia, Vic) is interested in the 17in T.V. receiver and suggests that for this and other projects we should indicate the alternative valve types for those specified.

A. Many thanks for your suggestion J.M. and we appreciate your problem. Unfortunately, such a procedure is not as simple as it sounds. The situation you mention is only one combination of possible types. There would be many others, some of which are more readily useful than others, according to the degree of circuit change, socket change, etc. necessary. In the circumstances we can only publish the preferred types and leave it to the experimenter to make his own investigations of alternative types. In most cases, where the valves are on hand, this is not difficult and very little is risked if the idea has to be abandoned. In the case of the types you mention we feel that they would work in most cases, though we have not had the opportunity to try them ourselves and so cannot forecast their behaviour exactly.

S.L.M. (Wingham, N.S.W.) encloses a number of queries for the Answer Tom feature and has some favourable comments to make regarding our journal.

A. The query concerning wattage consumption of receivers has been dealt with in at least two recent issues and we suggest that you look them up. We shall file the rest of the queries for use at the earliest opportunity. We thank you for the appreciative comments and trust that you will continue to enjoy our publication.

L.W.R. (Applecross) is thinking of building a portable radio receiver using transistors but would like to wait for our design, that is if it is not likely to be too long in forthcoming.

A. We are seriously considering the design of a transistorised portable receiver but cannot make any definite promises for the near future for a number of reasons. The most important is that supplies of the necessary high frequency transistors are not in sufficient quantity to cover likely demands at the moment and may not be so for some months. Also suitable coils for the receiver are not as yet obtainable and before they could be released on the general market a period of design and development would have to take place. Finally, the circuit development and final proving is a major project which will require the expenditure of a considerable amount of energy on the part of our staff. Unless you feel very confident of your knowledge of transistor principles etc., we would not recommend that you undertake the design of such a receiver independently.

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Whatever the subject matter, we must work on the principle that a letter is too involved if the reply takes more than 10 minutes of our time.

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To those requiring only circuit reprints, &c., we will supply for TWO SHILLINGS diagrams and parts lists from our files covering up to three constructional projects. Scale blueprints showing the position of all holes and cutouts in standard chassis can be supplied for 5/-. These are available for nearly all our designs but please note they do NOT show wiring details.

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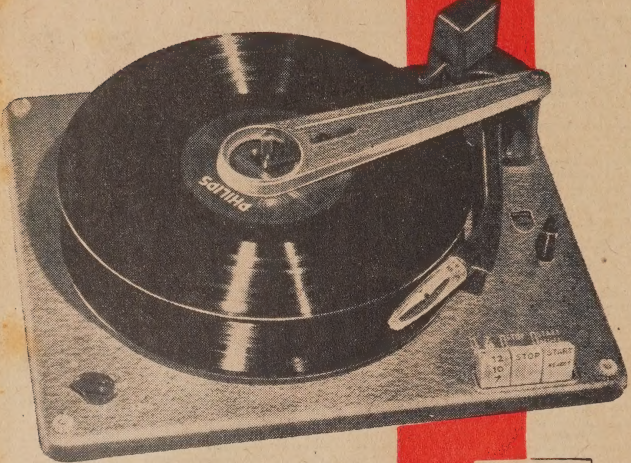

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e Cove, N.S.W.) sends two questions 'e's Your Answer Tom" feature.

thanks for your interest. Your ques- :en filed for publication and will be soon as possible.

id, N.S.W.) asks about the distances to send morse code signals.

suitable conditions, it is possible to code signals anywhere on earth by If connecting wires or cables are possible to send signals around the h quite involved repeater and am- rks required. The simplest way morse communication over distances of one mile is to run a connecting the two points and then use the return circuit.

lvern, Vic.) forwards details of an for use in conjunction with a clock enables the volume to be set at a assist slumbers in the evening but adjusts itself to a high volume when n in the morning.

for your interest and, as suggested, your letter for possible future use ader Built It" page. The remainder rks were read with interest and we ilarly happy to pass your appreciative to Mr. Walters.

part, Tas.) asks about the purpose quency oscillator in a receiver and ntend to publish another shortwave

lated morse code signals are heard y receiver only as a change in the oise level and when the signals are y not be audible at all. An oscil- receiver can be mixed with the in- at the detector valve when a signal difference between the two will be output. By varying the B.F.O. fre- ote can be varied. We would like other shortwave handbook but pres projects which seem to take an in- nt of laboratory developmental time o by make it very difficult.

Fremantle, W.A.) asks about the for the Three Band Two receiver de ly. Also he would like to know if can be operated from batteries.

broadcast coil was intended to be and full details were given on page ay issue. The coil had a tuned ed for the cathode of the valve it may not be possible to buy a nercial coil. A 4.5 volt supply suitable for the valve heaters and -volt supply, the current drain would t, making the operation of the set ve. Results would probably be le with a 90 volt high tension supply operation at least.

alla, S.A.) is very interested in the munications equipment described ago, but would like to see the packset suitable for this type of d. He makes a number of general ong them that the range we suggest s is too low

ree that a packset design would ning, but it takes time to design, onstruct laboratory models of equip- sort. In the meantime there are her projects demanding considera- on of stations 100 miles away with is certainly possible, and, judging comments, must hap(pen fairly ver, everyone building a crystal set such performance, and it is bet- persuade our younger readers to oney on a project, which has small ccess. A maximum range of 15 ir estimate. Your remaining re- ead with interest.

tersham, N.S.W.), has recently posals transceiver and would like some of the markings on the

ceiver function switch would ap- rol the automatic volume control quency oscillator. In the "CW" ould imagine that the BFO would n and the AVC rendered inopera a very long time constant. Un- rse code signals would be received n. With the control switched to FO would be switched off and the g normally for the reception of signals i.e., normal speech. In AN" position both the AVC and ld be switched off. This position l for the reception of modulated nd also of a relatively weak sig- sence of interference from a strong transmitter function switch would ansmitter to send unmodulated in the "CW" position, modulated in the "MCW" position while the ould modulate the transmitter in " position. The "CRASH LEVEL" he maximum audio output of the aves the operator from distress in of heavy interference. Finally. DYNE" knob determines the fre- heterodyne beat note when the tched to the CW position.

eld, Vic.) writes to describe a phenomenon concerning the effect set on two adjacent receivers, the ese latter being reduced on all stations except the one to which the set was tuned.

A.: This appears to be a simple case of the crystal set functioning as a wave trap. The fact that the other sets were operating on inefficient aerials and were probably so old as not to employ AVC would contribute to the effect. The presence of a large aerial in the immediate vicinity of the other sets would rob them of some energy. This would be least at the frequency to which the set was tuned, since the tuned circuit would present a high impedance at this frequency.

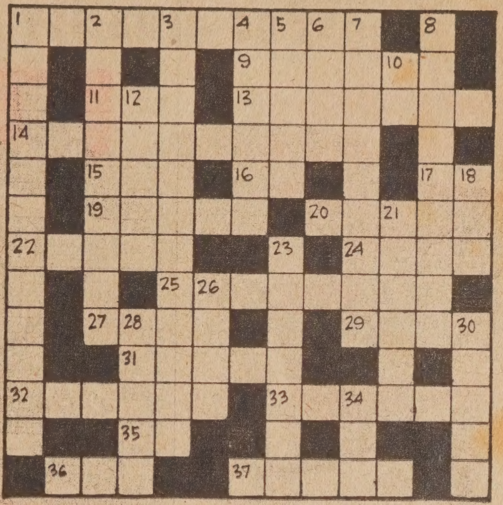
M.J.A. (Vermont, Vic.), forwards a query regarding the purchase of a back issue containing the Playmaster Baby Tuner.

A.: The Playmaster Baby Tuner was described in the May, 1956, issue and we have a number of copies left. These are available, through the query service, for a fee of two shillings.

R.G.B. (c/o H.M.A.S. Cootamundra) asks about back copies of Radio, T.V. and Hobbies and also if we have described amplifiers suitable for operation in conjunction with tape recording equipment.

A. Of the list of back issues you give the only one we are able to supply is that for June 1956. The cost is 2/-, which includes postage. We have published several articles on tape recorders and tape amplifiers. Of these, the articles most likely to be of interest to you appeared in the issue for March, 1953. Unfortunately, the complete description is no longer available but copies of the circuits are available through the normal 2/- query service.

THE R., T.V. & H. CROSSWORD No. 38



ACROSS

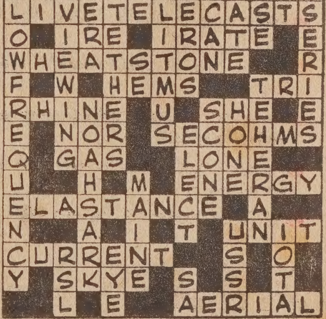
1. Valve element (2 words).
9. Non-metallic element used in medicine.
11. Point of a compass.
13. Relieving pain.
14. Unit of elimination.
15. To sit—past tense.
16. Preposition meaning towards.
17. In the matter of.
19. Becomes fatigued.
20. To talk.
22. Musical instrument.
24. To dislike strongly.
25. Blood-sucking insect.
27. Locality of the trouble.
29. To dry out something.
31. Carrier for photographic plates, etc.
32. Elongate plate of dense connecting tissue supporting the eyelid.
33. Dragged or pulled with effort.
35. Prefix meaning no longer.
36. To blend.
37. Resistance paralleled across meter terminals.

DOWN

1. Capacitance effect between parts of the same component (2 words).
2. Variable resistors.
3. TV tube functioning photo-electrically.
4. Being of super-human size.
5. Musical composition.
6. Image made as an object of worship.
/. The marsupial.
8. Converter of mechanical energy into electrical.
10. New York (abbrev.).
12. To dye.
18. To add.
21. Consuming.
23. Cuts off receiver output when no signal is forthcoming.
26. Early American engraver who produced the first lithograph.
28. County in England.
30. The margins, edges or borders.
34. A pistol, rifle.

Solution and further crossword next month

Last Month's Solution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RHINE U SHE E
E NOR SECOHMS
Q GAS LONE
U H M ENERGY
ELASTANCE A
N A I T UNIT
CURRENT S O
Y SKYE S S T
L E AERIAL

Printed and published by Sungravure Ltd., at the registered office; 21-29 Morley Avenue, Rosebery, N.S.W.

G.S. (Ashburton, Vic.) has some questions about valves in television receivers.

A. Valves in a television receiver, including the picture tube, can be expected to have a life comparable with those in a normal sound receiver and may easily last for many years before replacement is necessary. The number of stages in which even the best transistors available at this time can be used is limited and it would probably be more trouble installing a special power supply for them than would be warranted. The power saved due to the high efficiency of the transistor would be only a small fraction of the total power required by the receiver.

J.S. (Bairnsdale, Vic.) complains of a humming noise in his version of the "Three-Band-Two" receiver which was described in the May, 1957, issue. The level of the hum is affected by the setting of the volume control.

A. Most likely cause of the noise is pickup of electric hum fields by the control grid of the 6U8 pentode section (pin 2). Both the 0.68 meg. resistor and the 100 pF capacitor should be close to the socket and, in the normal way, the leads should not be more than about ½in from the main body of the component to the valve socket. Filament and other leads from the power transformer shoruld be kept away from this point. With exceptionally sensitive headphones, the hum due to the ripple in the high tension line may be objectionable. It could be reduced by placing a .047 meg. resistor in the line between the 16 uF filter capacitor and the junction of the two .1 meg. resistors. This latter point should be bypassed by an electrolytic capacitor. A suitable value would be 8 uF or 16 uF.

C.A. (Launceston, Tas.) would like to obtain back issues containing the "A Course in Television" series.

A. Unfortunately, the complete course is no longer available but we can forward the May, 1956, issue containing Part 9 and all issues to date. The usual charge is 2/- per copy, postage included.

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